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AUDITORY AND VISUAL MECHANISMS IN FOOD-FINDING BEHAVIOR OF THE HERRING GULL

BY HUBERT FRINGS, MABLE FRINGS, BEVERLEY COX AND LORRAINE PEISSNER

THERE are many places along the sea-coast where gulls (*Larus* sp.) regularly gather to feed: refuse dumps, fish-processing factories, docks where fish are loaded and unloaded. Dumps are almost always littered with edible materials, and gulls stay on them all day. They obviously learn to recognize trucks bringing food and flock in whenever one of these appears. Fish-processing factories and fishing wharves are also closely observed by gulls. At sardine packing plants where the offal is carried to bins by a "chum belt," the mere sound of the motor driving this belt immediately attracts those gulls within hearing range. In these cases, the association between food and sensory cues may be either visual or auditory, and it is obviously learned.

In specialized situations, such as these, it is easy to explain the accumulation of flocks of gulls as food becomes available, if one is satisfied to know merely the sensory cues involved. But at most places on the sea-coast one sees only an occasional gull flying over the water's edge or poking the sea-weed looking for tid-bits. Yet one need only throw fish or other food into or near the water, and gulls accumulate rapidly. What brings them from such distances to this food?

Fishermen and other coast-dwellers believe that gulls have a keen sense of smell, or that they have a "sixth sense." None of the scientists who has studied the behavior of gulls, certainly among the most studied of birds, has dealt with this behavior pattern.

Obviously, this attraction to unfamiliar food sources is the first step in habituation to a feeding area; consistent feeding soon results in a large resident, trained population. The original attraction almost certainly involves some means of communication among the gulls. For these reasons, it seemed of interest to study how gulls become aware of food and transmit this information to other gulls where no local predilections or permanent aggregations existed.

General Procedures

The study was made on the coast of Maine, mostly near Salisbury Cove on Mount Desert Island. This island has a highly indented, rocky coastline, with many coves and projecting points of land. Any place on the coast, therefore, can be seen only for a short distance (less than one kilometer) from the same shore. At almost all places, there is a visible opposite shoreline, across a bay. Where this work was done, the opposite shore is about

four to five km. distant across open water. Many smaller rocky points and projections produce extremely limited cones of visibility at some places.

The studies were confined almost exclusively to the Herring Gull (*Larus argentatus*) which is the most common gull of this region. The Great Black-backed Gull (*Larus marinus*) is present in small numbers also, and some observations were made on it.

The major work was done from June 30 until August 28, 1954, experiments and observations being made only in non-stormy weather. The observation areas were at some distance from the breeding grounds of the gulls, and there was no evidence of breeding behavior. About July 1, juvenile gulls appeared with the others and increased in numbers until midsummer. There was no feeding of these immatures by the adults, although once or twice young were seen begging fruitlessly for food. In general, the behavior patterns associated with breeding and rearing young, as described so admirably by many earlier workers (Goethe, 1937; Tinbergen, 1953), were not observed. These gulls seemed intent only upon finding food for themselves, and otherwise merely rested on the water or on the rocks.

To separate auditory from visual cues in food-finding, the sounds made by the gulls were recorded with a tape recorder (Pentron, Model 9T-3C) and later broadcast to the birds through the recorder coupled with an amplifier (Stromberg-Carlson, Model AU42, 15 watts output) and one or two trumpet-type loud speakers (University Model PA 30). When specific calls were found to give specific behavioral responses, these were re-recorded from original tapes onto continuous repeating cartridges and broadcast with a small repeating tape recorder ("Message Repeater") through the amplifier and speakers. Power was supplied either by connection with available 110-volt, 60-cycle source or by converters activated by 6-volt storage batteries.

Possible Sensory Mechanism used in Food-finding

Where interpretation is relatively simple, such as at factories, learned visual or auditory cues are used by the gulls in food-finding behavior. These two senses, therefore, suggest themselves as probably involved in the wild conditions. Such an idea would be further supported by the well-known visual and auditory powers of these birds (Tinbergen, 1953). The visual cues which might attract gulls to a site previously not associated with food include: (1.) the presence of a human being; (2.) the act of throwing something by a person; (3.) the fish being thrown or placed; (4.) the splashes made by the fish, if thrown into water; (5.) the behavior of other gulls which have discovered the fish. The auditory cues include: (1.) the sound of the splashes made by fish thrown into the water; (2.) the calls of other gulls.

A common belief among fishermen, however, is that these birds have an acute sense of smell, in spite of the ornithologists' dictum that olfaction is generally poorly developed in birds. The idea that the gulls use an extra sense not possessed by man can only be admitted if the accepted distance senses fail to account for attraction to food-sources.

The Role of Olfaction in Food-finding

Presumably the odor of fish could attract the gulls. Tests of this hypothesis were easily made. Fish with a distinct odor, slightly rotten but still acceptable to gulls, were wrapped in a piece of thin paper and placed on a rock. A similar bundle containing stones was placed nearby on another rock. Some gulls had previously been attracted by slight feeding and these were afloat on the water within easy sight and presumably within easy range of the odor. The observers could smell the fish from their observation post, which was farther from the fish than was the gulls' observation post.

The gulls gave no indication of interest in the bundles. A few flew over, but without any sign of recognition of the food that was easily available. After about 15 minutes of this, a few fish were scattered about the rocks near both bundles. As soon as the observers left the spot, the gulls came to feed. They ate the fish which were visible, even picking up fish lying immediately alongside of the bundle containing the others. At no time did they show any interest in the odorous bundle containing the fish, although they could easily have torn it open and got them all. A repetition of feeding showed that the gulls were still hungry.

These bundles remained on the rocks from 2:30 p.m. until dark, about 8:00 p.m., and were untouched by the gulls. Early the next morning a cat found the wrapped fish and ate them. The cat, with its excellent sense of smell, was not fooled by the paper. The obvious conclusion is that olfaction plays little or no role in food-finding by the Herring Gull, a conclusion which supports earlier reports (Strong, 1914; Tinbergen, 1953).

The Role of Vision in Food-finding

If visual cues are used by the gulls in aggregating at food sources, the first question which arises is: how well do the gulls, as a population, have any given point on the coast under visual surveillance?

There is plenty of evidence that the sense of sight of most birds, including Herring Gulls, is at least as good as that of man (Donner, 1951; Tinbergen, 1953). Conceivably it might be better. Therefore, if a human observer at any given place on the coast can see a gull, it is reasonable to suppose that the gull can see the observer and would have that point under visual surveillance.

Counts were made of the gulls that could be seen afloat, resting on rocks, or flying at many places on the coast. Two methods of counting were used: the observer kept a continuous record of the gulls in sight, or the observer made a count every 30 seconds of the number of gulls in sight. The latter method proved to be simpler and quite useful for graphical presentation.

These counts showed that every point on the coast was under almost constant surveillance from floating, sitting or flying gulls. Only rarely would two or three minutes go by without a gull's passing in flight. Later experiments, in which gulls were attracted by feeding, showed that there were gulls floating on the water which had not been seen. It is difficult to see a floating gull from the land, with the sun glancing from the waves. It is quite easy to see an object on the shore from the water. The seemingly immediate attraction of a few gulls on throwing food could, therefore, result from visual cues.

Three of the suggested visual cues—human beings, the act of throwing, and the splashes—can be disposed of easily. The part of the shoreline where most of these experiments were made was traversed by many people each day, and tourists often stopped to admire the view. There was no apparent attraction of gulls to human beings if they merely stood on the shore. At special picnic areas for tourists, gulls often gathered, and there they were attracted by human beings, but not on the open coast. The act of throwing and the sight of splashes also were not, in themselves, attractive on the open coastline. One could throw stones without arousing much interest on the part of the gulls, unless he had previously been throwing fish. Occasionally, as one would start to throw or skip stones, a gull would fly from its resting place toward the spot, but this was not usual. This is not to suggest that splashing cannot become attractive, through learning, as happens near docks or boats where feeding is regularly done. Under conditions where learning is not involved, however, splashes or throwing as well as mere presence of a human being, are not attractive to gulls.

To test the possibility that the sight of fish being thrown is attractive to the gulls, artificial fish were made from pieces of aluminum foil molded into fish-like shapes. At a distance, these flashed in the sunlight as real fish did, but at close range they were obviously distinguishable from the real thing. They were tested by being treated, in the sight of gulls, as if they were real fish being thrown.

In one experiment, for instance, the gulls were resting on the water at a distance of about 0.5 km. from the place where the decoys were thrown. The gulls thus were able to see the flashing from the artificial fish, but at that distance presumably could not distinguish them from real fish.

The results are shown in Figure 1. Counts were made, at 30-second intervals, of gulls within a 15-meter radius of the place where the decoys were being thrown. At the start, there were three gulls resting on the water near the spot; the others were, as noted, at some distance. As soon as the decoys were thrown, even though the first were thrown on the shore to avoid splashing, the distant gulls rose into the air, flew over the artificial fish and formed a group on the water. Once they could clearly see the artificial fish, they were not interested in them as food, however. One imitation floated out into the interest-group, but only a first-year gull pecked at it a few times in a desultory manner. The others ignored the decoys, and shortly flew away, when nothing more substantial was offered.

Other tests substantiated these results. The flashing of objects through the air is attractive to gulls. A similar response was observed at a sardine cannery, where damaged tin cans thrown from a window attacted the gulls' attention. In the experiment described above, a situation was selected in which

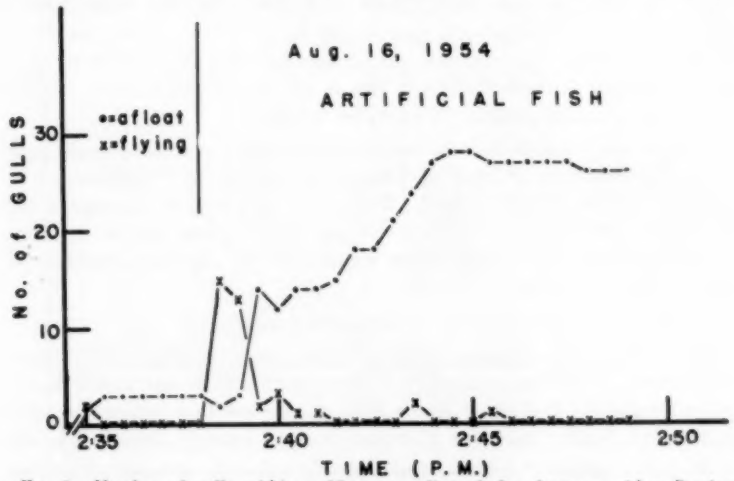

FIG. 1. Number of gulls within a 15-meter radius of the observers, either floating on the water (●) or flying (×), during sham feeding. From 2:35–2:38, there were no untoward activities by the observers. From 2:38–2:40, artificial fish made of aluminum foil were thrown on the shore and in the water and left there for the remainder of the test.

many gulls were near enough to see the flashes. Under ordinary circumstances, with few gulls able to see a given part of the coast, the response is quite small. Thus, this alone does not account for aggregation of large numbers under normal circumstances.

The flash alone is not sufficient to cause gulls to try to feed. If the gulls are close, so that they can clearly see the artificial fish, they do not approach at all. Or, if the artificial fish are scattered about on the rocks, flying gulls give them only passing attention.

The last visual possibility is the behavior of other gulls as witnessed by the birds. There are two patterns of behavior which gulls exhibit when they sight food that could attract others. First is a special flight pattern over the food. If a flying gull sights food, it executes a "figure-8" pattern of flight over the area, losing altitude on the straight arms and gaining altitude as it circles at the ends. This flight pattern, if continued for more than two or three turns, induces other gulls within sight to approach, even though the flying gull remains silent. If food is present and recognizable, they too will execute "figure-8's." If this alone were active, however, only a few gulls would arrive in a short time.

The second behavior pattern is the tendency to accumulate in interest-groups on the water near food. Once an interest-group has formed, other gulls flying near will approach, even though the gulls in the group are silent. If food is present, they will join the group. Actually, the interest-group is not an original attractant and acts late in the attractive sequence, because it requires the prior presence of a number of gulls.

Thus, in the situation here studied, two visual cues can be used by the gulls in food-finding: the flashing of fish-like objects and the flight-pattern of gulls which have discovered food. While every spot is under constant visual surveillance the number of gulls which can see any given spot at any time is usually small. Thus they cannot account for the rapid accumulation of large numbers of gulls.

The Role of Audition in Food-Finding

At breeding areas, Herring Gulls are quite vocal, (Goethe, 1937; Tinbergen, 1953). Under the conditions of these studies, they were mostly silent, except during the feeding or shortly after dawn when they engaged in some vocalization, mostly restricted to trumpeting and mewing, described below.

There was plenty of evidence that auditory cues were of great importance in food-finding. This is well illustrated by the data shown in Figure 2. In this case, counts of gulls within sight at any distance were made at 30-second intervals, at first with no untoward activity on the observers' part, then when stones were splashed into the water, and finally when fish were thrown. The slight interest aroused by the splashing of stones is plain. As soon as fish were thrown, one of the gulls nearby emitted a special call, which was later taken up by others off and on, as indicated on the graph. Immediately, gulls began to come to the spot. These were not merely gulls that had been near-

by; the graph shows all gulls which were visible, regardless of distance. The gulls flew toward the spot from around neighboring high points of land, even over the tops of trees on the points. It is this attraction of gulls from places where they cannot see the food that has led fishermen to postulate a gull "radar."

There were two sounds which might be active, the splashing of the fish and the calls of the gulls. Splashing could almost be ruled out without further tests, on the basis of many experiments such as that described above. Perhaps, however, one might think that fish make splashes which the gull can distinguish from those of stones. Two tests were made of this. First, at a place on the coast where a number of gulls were resting on rocks we mounted a large rocky point of land about 0.5 km. away from the gulls. This point shielded our activities from their view but not from their hearing. There stones were thrown into the water, with no interest on the part of the gulls. Then fish were thrown into the water. Again the mere splashing sounds were unattractive. Climbing on the rock, so that the gulls could see, we threw

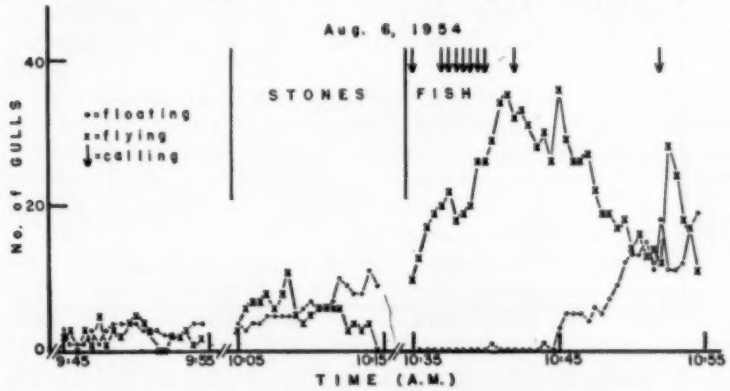

FIG. 2. Number of gulls in sight, either floating on the water (●) or flying (×), before and during feeding with fish. From 9:45–9:55, there were no untoward activities by the observers. From 10:05–10:15, stones were thrown into the water noisily. From 10:35–10:55, fish were thrown into the water. The times at which the special call of gulls at feeding areas was given are indicated by the arrows.

stones first, then fish. The gulls remained on the rocks when stones were used, but came immediately when fish were used. In this case, there was no interest in mere splashes. The interest in splashes of stones in the tests shown in Figure 2 was probably due to the fact that the experiment was done where the gulls had been fed previously.

The second test of the attractiveness of splashes was made with recorded

splashes. Both stone-splashes and fish-splashes were recorded, again with the possibility in mind that gulls might be able to distinguish between them. These splashes were played to gulls under many different conditions. At no time was there more than transient interest, nor any sign of differentiation by the gulls between the splashes. If a gull were flying quite near to the loud-speaker, it would turn as the splash sounded as if looking for the source. When this was not apparent, it paid little further attention.

Very early in the work, we noted a special call given on the wing by gulls when they found food in quantity. This call we later named the food-finding call, after its importance in this activity was found. It has three main notes, the middle one higher-pitched than the other two and accented. So

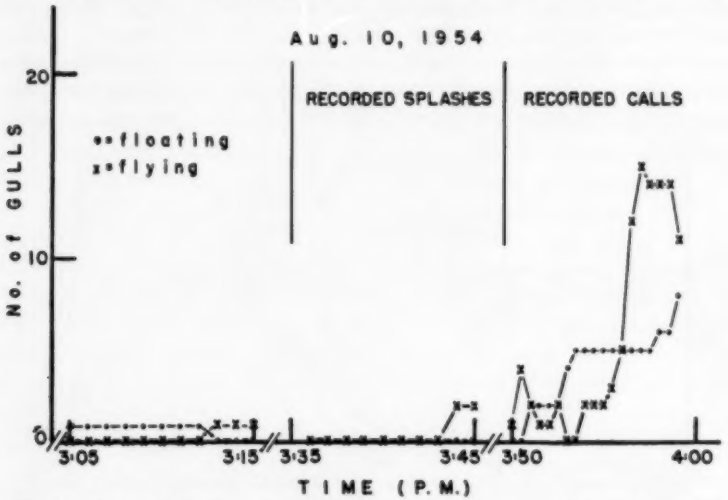

FIG. 3. Number of gulls in sight, either floating on the water (●) or flying (×), during tests of attraction by sounds. From 3:05–3:15, there were no untoward activities by the observers. From 3:35–3:45, recorded splashes made originally by throwing fish in water were broadcast. From 3:50–4:00, the recorded food-finding call was broadcast.

far as we can determine from syllabic renditions in the literature or descriptions of behavior to calls by earlier workers, the significance of this call has not been recognized previously. After our failure to decipher earlier workers' syllabic designations of calls (unaccompanied by descriptions of the actions of the birds), we conclude that it is useless to invent syllables to represent this or any call. It can be heard by anyone who so desires merely by feeding gulls, or we would be glad to exchange recordings, where feasible.

As Figure 2 shows, this call seemed to bring in many gulls. It was

recorded, therefore, and played back without presentation of food. The results of one test are shown in Figure 3. The counts represent all gulls visible to the observers, and the observers in this case were on a point of land rising sharply about 10 meters above the bay, so that visibility in all directions over the water was excellent. One gull was in sight, afloat near the point, as the counts began. This individual remained thus for eight minutes, then flew up and circled around. The counts was repeated as before, without activity on the part of the observers, with the same results (not shown on the graph). After that, the recorded sound of splashes made by throwing fish into the water was broadcast. As can be seen, no gulls were attracted. Following that, the recorded food-finding call was broadcast. This was mixed, in the recording, with squeaks of immature gulls which had been with the adults when the original recording was made. The results shown on the graph speak for themselves. The gulls which came toward the speakers flew over treetops and around points of land which certainly cut off their vision, had there been anything to see. They flew around the area, then settled on the water in an interest-group. When the sound was turned off, they stayed for 10 or 15 minutes and then dispersed one by one.

These observations were repeated many times at many places along the coast and even up to three or four km. inland. The gulls on this coast seem to have a much greater degree of auditory surveillance than of visual surveillance. So far as could be determined, auditory surveillance of any spot by many individuals was essentially continuous.

There was no doubt that the food-finding call attracted gulls within hearing range. It remained to be seen whether this call was specific or whether any call by gulls would be attractive. For tests of this, the calls of Herring Gulls were recorded under many different circumstances and later broadcast to the birds. The behavior of the gulls was observed as other gulls emitted the calls and when the recorded calls were played. On the basis of these tests, we were able to identify five or possibly six calls to which distinct reactions are given.

The Herring Gull's Vocabulary

The food-finding call.—This has already been described. The only syllabic and notational representation in earlier reports which seems similar is given by Goethe (1937) as one of the many under "Lock und Wanderruf," but he does not identify it as having any special significance. Collias and Joos (1953) have identified a food-call in the domestic fowl to which the chicks react by approaching the source.

The food-finding call of the Herring Gull is emitted when gulls see food, particularly if other individuals are already present and there is food in

some quantity. It is interesting to note that small quantities of food discovered by one gull will usually be consumed without vocal announcement, while large quantities will elicit the call.

The trumpeting call.—We designated the second clearly-defined call with this term, adopting the one used by Bent (1921), Tinbergen (1953) and others. This has been described in detail by earlier workers, and it has considerable significance during breeding (Portielje, 1928; Goethe, 1937; Tinbergen, 1953). The only reaction to it in feeding (non-breeding) gulls seems to be occasional chorusing. Gulls feed on dumps in large numbers, and, during the feeding, there is an almost incessant chorus of trumpeting, mixed with other calls. The only evidence, however, of a special reaction to the trumpeting is imitation on the part of other gulls. The same results could be obtained with recorded trumpeting.

The mew call.—The third clearly defined call is the "mew call," a term used by Strong (1914) and Tinbergen (1953). This likewise has been described by many other earlier workers: Boss (1943) as "cat-like," Portielje (1928) as "Zärtlichkeitsausdruck," Goethe (1937) as "Nestruf." The last two terms suggest that this is used only during breeding. It is common all summer among non-breeding Herring Gulls. The acoustically descriptive term, "mew" call, seems thus to be preferable. It sounds much like the mewing of a cat, mournful and somewhat ridiculous.

The functions of this call in mating and brooding behavior have been fully described by Goethe (1937) and Tinbergen (1953). In the case of non-breeding gulls, we were unable to discover any definite reaction to it. Often the mewing individual would be alone on a rock and would continue with this sound for long periods of time. Occasionally, the sad solo would be punctuated by the trumpeting call, which would trail off finally into the mew call. At no time was any attraction observed as a result of this call, nor even joining in of other individuals, as with the trumpeting.

Once we observed what looked like the use of the mew call by one gull to direct a group of its fellows. Fish for the gulls had been thrown very close to the microphone of the tape recorder and the observers remained rather close. The gulls were quite wary, and, after initially coming in as if to feed, gathered in an interest-group about 10 meters away on the water, while one gull sat on a rock nearby. Whenever this gull was silent, the group on the water swam slowly toward the fish near the shore. When they came to within about four meters of the fish, however, the gull on the rock would begin the mew call. The others would then slowly swim back to their original stations. This continued for about half an hour, during which time the observers did not move appreciably, and the group of swimming gulls made a number of trips in and out. Finally a juvenile gull flew

over and landed at the fish. Immediately all the others swarmed in and the clamor drowned out the voice of the mewing gull. This may have been accidental, or it may have shown a use for this call, aside from those in the breeding season.

The alarm call.—The fourth clearly defined call has also been described previously. It was noted by Dutcher, *et al.* (1903), called the alarm cry or call by Strong (1914), Bent (1921), Boss (1943) and Tinbergen (1953), "Schrecklaut" by Portielje (1928) and "Angstlaut" by Goethe (1937). We have offered a description of it elsewhere (Frings, *et al.*, 1955) and adopted the term, alarm call. Usually it consists of two parts: (1) an attention call of two notes in a descending sequence given very sharply, and (2) the alarm call proper, consisting of two or more, usually three, repeated staccato single notes, with major accent on the first in each series. The attention call is possibly the "Charge Call" of Tinbergen (1953), the "Wutlaut" of Portielje (1928) and the "Schrecklaut" or "Warnruf" of Goethe (1937), although this cannot be decided clearly on the basis of their syllabic descriptions. We prefer to designate it tentatively as an attention call, because it brings gulls up from their resting places and toward the source. It may be used also in conjunction with the food-finding call to bring gulls to feed. It thus seems to be ambivalent in effect, attractive or repellent, depending upon the intensity of expression and the sequel.

Earlier workers have described the circumstances under which the alarm call is emitted by gulls in a breeding colony. The call is most usually heard among foraging gulls when unusual circumstances exist near the feeding area. The presence of a person or a piece of equipment, such as a tape recorder, near the feeding areas induces some to give this call. The call is also given by gulls on sighting one of their fellows in the hands of a captor. This reaction may account for the repellency of captive or dead gulls to free birds. Our recordings were made as captive gulls were held in sight of others, or later during feeding at the place where the captive gulls had been exposed.

The reaction of gulls to the recorded alarm call is striking. With the first notes of the attention call, the gulls rise from their places of rest and fly toward the place from which the call arises. As the alarm call proper is given, they slowly fly away. Only one sequence of the call, consisting of the attention call and two or three repetitions of the alarm call will bring this about. In silence the gulls circle slowly higher and higher and finally out of sight.

The effect when this is done on a dump is rather uncanny. The dump may be crowded with hundreds of gulls, shrieking, trumpeting, flying around. When the alarm call is broadcast once or twice, the gulls rise into the air

as one, and in sombre silence glide away, with only a rare attention note from some individual in the flock. Within a few minutes, the dump is deserted and silent. The recorded alarm call was tested as a repellent for gulls on dumps and near fish-processing plants (Frings, *et al.*, 1955). It was possible to repel gulls from these areas and to keep them away for up to two full days merely by playing the recorded alarm call whenever they tried to return.

These four calls of the Herring Gull are found also in the repertory of the Great Black-backed Gull, but pitched about one octave lower. This was checked by recording calls of this species at a tape speed of 3¾ inches per second and playing them at 7½ inches per second, or the reverse with the Herring Gulls' calls.

There seemed to be almost complete cross-reactivity with these species of gulls in the food-finding and alarm calls. The calls of the Herring Gull were effective with Black-backed Gulls and vice versa. This is undoubtedly due to the flocking together of these species and the fact that the alarm calls of all gulls are quite similar (Bent, 1921). The alarm call of the Herring Gull was tested on Laughing Gulls (*Larus atricilla*) in New Jersey, and found to be effective in driving about 5,000 of them from a city dump. Thus there is considerable cross-reactivity in this case too.

Single-noted calls.—The fifth family of calls consists of grunts, clucks and other single-noted calls to which we observed no obvious reactions. These have also been mentioned previously, and Goethe (1937) has attempted an elaborate classification, mostly under "Lock und Warnruf." It is impossible, however, to recognize any particular notes from his elaborate syllabic representations. It is our belief that some of these represent incomplete calls of other types. Certainly listening to the tape recordings suggests this, for these notes often follow or precede complete, clear-cut calls and seem to be fragments of them. At any rate, these clucks or "call notes," to use Tinbergen's (1953) term, seem to be only loosely related to feeding, being heard more often among a large group of feeding gulls. The other calls also, except for the alarm call, were most common during feeding.

A possible "departing call."—One other call seems worthy of mention. This is what might be called a "departing call," matching that reported by Faber (1936) in Orthoptera. If a group of gulls were sitting on the water and one flew up suddenly and silently, the others often rose into the air also. This was noted also by Goethe (1937) at the breeding grounds. Usually, however, if a gull rose off the water without obvious alarm, it would emit a very brief, low, two-noted call, without easily definable tonal qualities, but very characteristic once heard. This seemed to have the effect of keeping the others on the water. Obviously, the testing of this call is very

difficult, because its essential result is to maintain the *status quo* among the gulls hearing it. This observation is presented merely as suggestive and should be subjected to critical testing. Suffice it to say that we could recognize this call ourselves and knew, without seeing, when a gull was leaving a group.

The young gulls only gradually develop the ability to produce these and other calls, as all previous workers have noted. Juvenile Herring Gulls emit only high-pitched squeaks, sometimes sounding like falsetto versions of the food-finding call. Older juveniles have these squeaks, plus a rasping rattle which they emit at feeding areas. These squeaks and rattles are quite attractive, when recorded and played back to gulls, both young and adults. Being of high frequency, they do not carry as well as the food-finding call of the adults, but are attractive for those within hearing range.

Summary of Mechanisms used in Food-finding

The food-finding behavior of the Herring Gull, under the conditions observed, involves the following:

1. Almost constant visual surveillance of all parts of the sea-coast by a few, and constant auditory surveillance by many gulls.

2. Visual recognition of food by gulls. This, in the case of fish, apparently is first by the sight of shiny objects being thrown or lying near the water's edge. Only if the fish can be identified as such, on closer examination, however, will the gulls try to feed. Visual cues may easily be reinforced by learning, if feeding occurs regularly at a given spot, causing the gulls to come almost as soon as a person appears or is in the act of throwing.

3. Visual attraction of small groups. The flight pattern of Herring Gulls that have found food is attractive to other gulls which can see the pattern, yet may not be able to see the food. This can result in the appearance on the scene of a small number of gulls.

4. Auditory attraction of large groups. Usually, one of the gulls visually attracted emits a special call, which we have named the food-finding call. This attracts most gulls within hearing, which apparently may be up to 3 to 5 km. distant across open water. As new arrivals come, they too emit the call and more are attracted.

5. Formation of the interest-group and feeding. Usually the gulls first form a group near the food. This arouses the interest of any flying gulls which see it, even if the gulls are silent, and the group grows. From this group individuals fly over the food. If one lands to feed, the others fly in and the welter of calls which then arises may attract still more distant gulls. Shortly the gulls return to the interest-group and await further feeding. Even when food is continuously present, feeding seems to be more or less rhythmic

from interest-groups. If a person throws some more fish, or if a new individual alights to feed, the others again fly to the food, with much noise. Shortly, however, the gulls return to the group area, often leaving some food untouched, to repeat the feeding rush as before within a short time.

General Discussion

Most of the interest in behavior of birds has been in breeding, nesting, and migration. The feeding activities of birds, however, also offer a rich field for study of communication and social behavior. It is tempting to theorize at this point, and to point out that the communication here studied is for the purpose of social assistance and not competition, as is usually studied in experiments on feeding. We prefer, however, to present our data and interpretations without attempts to fit them into any existing theories or to devise new ones.

One item seems worthy of serious note. Earlier workers who studied reactions to or production of sounds by gulls have published detailed reports of their findings. In these, they use syllables or occasionally musical notations to represent the calls of the birds. One soon finds, however, that only their descriptions of the behavior of the gulls allow him to correlate these calls with those he has heard. As Armstrong (1947:75) writes, "Without recording apparatus appreciations of bird song are apt to be so subjective that their scientific value is questionable." Obviously it now is possible to record bird calls easily and to break them down from mere "songs" into informational bits by means of tape recording. With this arises a need for some means of communication among workers, and this obviously is impossible by syllables or bare musical notes which are meaningless without personal explanation.

Field recordings of sounds of animals to which the observer adds, at the same time, oral descriptions of behavior are excellent for later study. They allow the observer to keep a continuous watch on the animals and yet to record immediately his observations. Tinbergen (1953:164) notes that his moving pictures showed a particular posture of the gull in its charge flight which he had never noticed in the field. This sort of thing happens also with sound recordings. In one of our recordings, for instance, the observer remarks that she has not heard the food-finding call, yet the gulls are coming in. Only about five seconds before this remark was made, however, the call is clearly recorded, obviously being given by a gull not in the group on which the observers' attention was fastened. This human tendency to focus attention on some phase of the environment to the exclusion of others may be valuable for much work, but it can lead to mistaken observations in broad field situations. The tape recording, played in a

quiet room, without visual distractions, quickly reveals the true situation. As Tinbergen (1953:164) writes, "It teaches one to be very careful in claiming that this or that does not happen because one has never seen it oneself." One might add "heard it oneself," as well.

A word might be said in a practical vein. Many animals which are pests—rodents, birds, insects—produce and receive sounds. Some of these sounds almost certainly are used by these animals for communication. If recorded, they might be used to induce behavior patterns which would aid in control of the pest species. These biologically significant sounds have advantages over mere noise or high intensity sounds: they are specific or nearly so; they need not be emitted at such high intensities that cost is prohibitive; they afford little or no danger to man. The possible future use of sounds in pest control will require many careful studies of behavior of animals in all their life-activities, and especially of their means of communication. It is to be hoped that increased interest in possible practical results will stimulate—and help to secure payment for—much-needed fundamental research in this field.

Summary

Visual and auditory communication in food-finding behavior of Herring Gulls on the sea-coast of Maine were studied using recording techniques to separate the two mechanisms. The gulls can be attracted visually by flashing objects of suitable size and by a typical flight-pattern of individuals that have found food. The major attractant outside the visual field, however, is a special call emitted by gulls that discover food. A study of sounds made by non-breeding gulls at food sources allows the designation of at least four distinct calls: (1) food-finding call, (2) alarm call, (3) trumpeting, and (4) mew call. These were recorded in the field with a tape recorder, and the reactions of gulls to broadcasts of the recorded calls were studied. The food-finding call attracts gulls from distances up to 3 to 5 km. The alarm call repels gulls from food or resting places. Trumpeting elicits only chorusing of nearby gulls. The mew call evokes no consistent reactions under these circumstances. Gulls also have a number of single call-notes, the functions of which are not clear. The alarm call of Herring Gulls induces Great Black-backed Gulls and Laughing Gulls also to fly away from the source of the sound.

Acknowledgments

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OBSERVATIONS ON THE AUTUMN MIGRATION OF BLUE GEESE

BY GRAHAM COOCH

THERE is much conjecture about the manner in which large flocks of Blue Geese (*Chen caerulescens*) make their autumn migration from James Bay to Louisiana. Although their route lies over an area well supplied with amateur ornithologists and sportsmen, the main James Bay flight frequently escapes detection. Soper (1942. *Proc. Boston Soc. Nat. Hist.*, 42 [2]:203) summed up the situation as it relates to the Baffin Island populations:

> Because of the high, fall flight ordinarily maintained by Blue Geese after leaving James Bay, practically none are taken along the regular migration route south of this point to the lower Mississippi. In fact, so seldom are these geese observed on this long and apparently uninterrupted flight of more than 1,000 miles, that very few records are extant to even indicate the time and nature of their movements.

The Route of the Southampton Island Population

Since 1952, 15,000 Blue Geese and Lesser Snow Geese *(Chen hyperborea)* have been banded at Boas River, Southampton Island, North West Territories, (63° 42′ N., 85° 45′ W.) and Eskimo Point, North West Territories, (60° 50′ N., 94° 25′ W.), and 1,300 of these bands have been recovered. The recoveries indicate that these populations do not migrate through James Bay but stop along the coast of Hudson Bay from York Factory, Manitoba, to Cape Henrietta Maria, Ontario. They migrate up the Nelson, Severn and Winisk rivers, skirt the north shore of Lake Superior, pass through western Minnesota and may stop in the lake country of eastern South Dakota. From there the flight is due south to eastern Texas. The distance covered from Hudson Bay to eastern Texas exceeds 2,100 miles, compared to the 1,700 mile flight required of James Bay populations. Perhaps the longer flight and the earlier date of departure from the Hudson Bay feeding grounds account for the difference in migratory behavior of the Southampton and Baffin island populations. Although in some years the flight of the Southampton Island goose population through the Dakotas is rapid and direct, years in which the birds interrupt their migration are more common. At Sand Lake Refuge, Brown County, South Dakota, major stopovers have occurred in seven of the past twelve autumn migrations.

The Route Through James Bay

The population migrating through James Bay apparently does not exhibit to the same degree this tendency to interrupt its flight, a factor contributing to the paucity of sight records. The lack of band returns from James Bay suggests that the Blue Geese breeding on Southampton Island do not migrate

through James Bay. Those geese which do so may breed on Baffin Island. To date no banding has been done on the Baffin Island breeding grounds, and the only records available on the flight of these birds are those from the McIlhenny bandings in Vermilion Parish, Louisiana. These data are not in sufficient volume to permit accurate plotting of the chronology of movement or dispersal patterns. In certain seasons the problem is increased by the apparent rapidity of the southward flight.

While engaged in waterfowl investigations in James Bay in September and October, 1952, the writer noted large flocks of geese flying up the Harricanaw and Kesagami Rivers (51° 08′ N., 79° 46′ W.) on the evening of

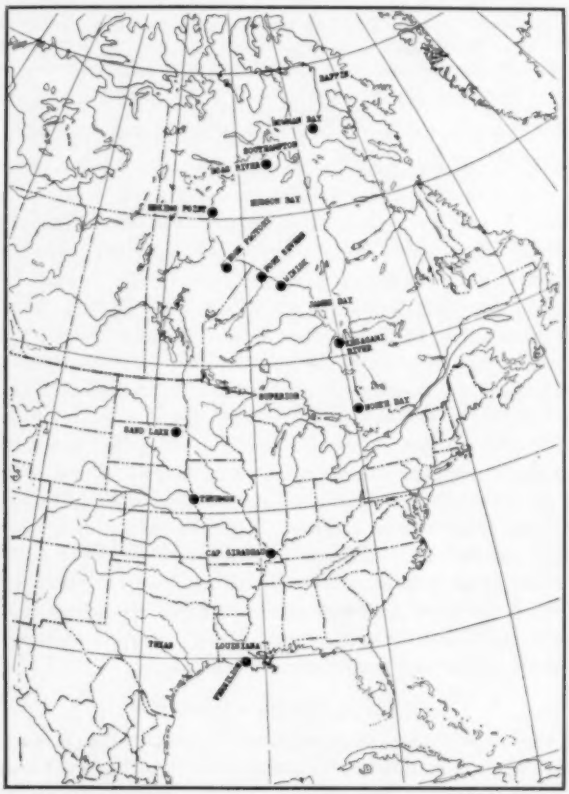

FIG. 1. Map of eastern North America showing the localities mentioned in the text.

October 16. The flocks gained altitude rapidly and headed almost due south. The weather was clear, and wind velocity at ground level was approximately 20 miles per hour, blowing from the northwest. Migrating flocks were heard continuously from 6:00 p.m. to 11:00 p.m.

On October 17, 1952, at North Bay, Ontario, all aircraft operating in the vicinity were warned that flocks of geese flying at 6,000 to 8,000 feet altitude constituted a hazard in the 50 miles lying to the north of North Bay.

Mr. K. R. Esselmont, Station Manager, in a letter to Mr. S. T. Howe, Cargo Representative, Trans-Canada Air Lines, Winnipeg, Manitoba, April 22, 1953, described the situation which existed on October 17. In the second paragraph of his letter he states:

> They were first spotted by the [Department of Transport meteorological] observer who saw them approach from the north east, flying in a southerly direction. There were three separate flocks at intervals of perhaps 5-10 minutes. The weather was clear from our station north and the overcast, consisting of altocumulus, began just over our station and extended south. The first flock, estimated at close to 200, approached the station in formation and immediately over the station they broke formation, flying in all directions and re-assembled in formation just prior to entering the overcast estimated at 8,000 feet.

Mr. S. T. Howe, in a letter to Dr. H. A. Hochbaum, February 12, 1953, quotes Trans-Canada Air Lines pilots who were at North Bay on October 17, 1952, as reporting many additional flocks of migrating geese at 8,000 feet. One aircraft was damaged in a collision with a goose and was forced to return to the airfield. North Bay is approximately 370 air-line miles south of the mouth of the Harricanaw River.

The next report on this movement of geese was obtained from Mr. L. E. Lemke, Thurmon, Fremont County, Iowa. He reported seeing large flocks of Blue Geese flying south along the Missouri River on October 18, 1952, at an estimated height of 3,000 feet. Although these birds were probably part of the Southampton Island flight, similar flights were reported by sportsmen at Cape Girardeau, Missouri, 800 air-line miles south of North Bay, Ontario. These latter flights were undoubtedly part of the Baffin Island population.

The last report of this migration was by Mr. John L. Lynch, U. S. Fish and Wildlife Service, Abbeville, Louisiana, who recorded the first large flights of Blue Geese arriving at Chenier au Tigre, Vermilion Parish, Louisiana, on the morning of October 19, 1952.

Thus it would appear that in 1952 the main flight of Blue Geese required less than 60 hours to complete a passage of more than 1,700 miles from James Bay to Louisiana. Soper *(op. cit.)* comments that, were a given flock of geese to migrate continuously at 45 miles per hour over the shortest possible route from James Bay to Louisiana, the entire journey would require only 40 hours.

During those seasons in which the geese pass rapidly through the northern

tier of the United States much concern and discussion results among sportsmen. In 1952, when the geese made a rapid flight directly to the Gulf of Mexico, an article entitled "Where Were The Blues?" appeared in the *Iowa Conservationist*, (December, 1952, Vol. 11 [12]: 91). Perhaps some of the mystery which now surrounds the autumn migration of Blue Geese from James Bay may be attributed to a rapid, direct, high-altitude flight. The reports of pilots and observers at North Bay, Ontario, are concrete evidence that the Baffin Island populations of this species make at least part of their flight at an elevation of several thousand feet, a fact long debated but never previously proved.

Acknowledgments

Many of the data necessary for documenting the movements of Blue Geese discussed in this note were supplied by Dr. H. A. Hochbaum, Director, Delta Waterfowl Research Station; Mr. L. E. Lemke, State Conservation Officer, Thurmon, Iowa; Mr. John J. Lynch, U. S. Fish and Wildlife Service, Abbeville, Louisiana; and pilots and officials of Trans-Canada Air Lines, North Bay, Ontario.

Canadian Wildlife Service, Ottawa, Ontario, Canada, April 7, 1955

SOME ASPECTS OF THE KINETICS IN THE JAWS OF BIRDS

BY HARVEY I. FISHER

KINETICS in birds' jaws, as used here, means a dorsoventral motion of the rostral portion of the skull on the cranial part of the skull. Where these two parts come together there is a frontonasal "hinge." The hinge is a horizontal bony plate variously composed of thin extensions of the nasal, premaxillary and frontal bones. Although there is definite articulation here in some species (parrots, for example), in most the movement is partly, if not entirely, made possible by the flexible nature of the thin bones in this region (Figs. 1, 2, 3).

Since the maxillary bones are firmly fused to the nasals in birds, the maxillary must move if the nasal bone moves. When the maxillaries move, the palatines, pterygoids and quadrates also move. As a matter of fact, the chain of sequence is in the opposite direction. Forces applied by muscles to the pterygoids and quadrates cause these bones to move, and their movement impinges on the next bone. The end result is, as we have said, a dorsoventral movement of the upper bill in birds.

Thus, the visible "jaw kinetics" in birds is but a part of the entire mechanism. Kinetics in the classical sense of comparative anatomy encompasses a much wider area including jaw suspension. Type of jaw suspension and kinetics have long been thought to vary with food habits. Differing food habits are also believed to be important selective devices in the evolution of animals. Thus the kinetics of jaws may be a fruitful field for the study of significant adaptations.

Most of the structural parts of the kinetic avian jaw have been known for some time (Nitzsch, 1816; and Huxley, 1867). The basic pattern of bone, muscle, and ligament is well established in the literature (Hofer, 1945, 1950; and Fiedler, 1951). However, it is the change from a basic pattern that is of primary interest to one attempting to correlate food habits with the details of structure and function. In recent years, workers (Kripp, 1933-1935; Engels, 1940; Beecher, 1950-1951) have emphasized the structural differences found upon dissection and have tried to correlate these with food habits. Observing the details of function in a living bird seems beyond the realm of possibility at present.

We must then try to visualize the functional aspect from the structural plan. This is a procedure fraught with the dangers of misinterpretation of the actions and co-actions of the many parts of the kinetic mechanism. Nevertheless, if we are to study this morphogenetic area or apparatus of the bird, we must do the best we can. All qualitative features must be known

and we must emphasize the quantitative nature of the mechanism. Subjective evaluations of quantitative materials are notoriously poor. Weight, volume and length of muscles, angle between muscle and bone, relative vectors of muscular force, length of work and force arms on the bony levers, and total movement of the upper bill are but a few of the features that should actually be measured. Knowing these, one can set up physical formulae to calculate the relative effectiveness of the varying jaw apparatuses found in birds.

Kripp (1933-1935) was one of the first to emphasize the functional view, but his complex lever systems fail to include the varying muscular forces that might be indicated, in a relative way, by weights or volumes. Barnikol (1951) studied the problem more recently on a qualitative basis. The only study, of which I am aware, that includes most of the variables known is Donald C. Goodman's (1954) unpublished analysis of the functional features of the kinetic apparatus in waterfowl.

Fisher and Goodman (1955) devised a reliable method of measuring the total movement at the frontonasal hinge.

This present study is designed to demonstrate some of the factors which affect the dorsoventral movement at the hinge between the rostral and cranial parts of the skull. It is by no means an exhaustive work. Rather, it is hoped that the paper will stimulate others to undertake the detailed and extensive studies that will be necessary.

Materials

It is the custom of many hunters of waterfowl at the Horseshoe Lake Refuge in Illinois to have their game cleaned and dressed by professionals. I obtained 75 heads of Canada Geese (*Branta canadensis interior*) and 23 heads of Mallard Ducks (*Anas platyrhynchos*) from these cleaners. Most of the kill was made before noon, and the heads were received shortly after noon. Thus the specimens were as nearly fresh as possible. One group of 20 goose heads was not measured until 24 hours after death.

The 17 American Crows (*Corvus brachyrhynchos*) used in this study were collected at Fairmount Quarries in Vermilion County, Illinois. All measurements on the fresh heads were made within eight hours after collection.

The Double-crested Cormorants (*Phalacrocorax auritus*) were taken from a single breeding colony at Spring Lake, Carroll County, Illinois.

At the Camp Creek Duck Farm at Monticello, Illinois, Pekin Ducks are dressed for market in the morning. We measured the kinetics in these young ducks in the afternoon of the day they were killed. A total of 103 heads of Pekin Ducks was provided by this farm.

Opportunism is evident in the list of materials. It is apparent that the specimens were not selected to show a wide variety of either taxonomic types or of food habits. To secure sufficient numbers of specimens for statistical analysis, it was necessary to choose species easily obtained.

The skulls are preserved in the Natural History Museum of the University of Illinois.

Acknowledgments

My wife, Mildred L. Fisher, and Dr. Donald C. Goodman and Mr. Lawrence P. Richards aided in the securing of specimens and in the measuring process. Mr. William P. Childers gave me the Crows, and the management of the Camp Creek Duck Farm provided the heads of the Pekin Ducks. The work at the Horseshoe Lake Refuge was greatly helped by permission to use the laboratory of Mr. Harold C. Hanson of the Illinois Natural History Survey. The Research Board of the University of Illinois aided financially. I wish to express my sincere appreciation to all these persons and agencies.

The Experiments

Preliminary dissections indicated that bony parts, ligaments and the muscles themselves might be factors restricting the amount of movement — either protraction or retraction. Method of preservation of the head, method of preparing the skeleton, and, when dealing with fresh materials, the length of time between death and the measurement were believed to be other factors affecting the apparent movement.

Experiments were designed to evaluate the:

1. Consistency in the results of measurement of skeletal specimens. Consistency might indicate the presence of a bony structure that finally stopped the movement, before actual fracture of the delicate hinge.
2. Limitations imposed by the bulk of the muscle mass, no matter whether these muscles were part of the kinetic mechanism or not.
3. Limitations resulting from the presence of ligaments, joint capsules, and strong fascia (see Fig. 4).
4. Validity of the use of museum skulls as an indication of the degree of kinetics in fresh specimens. It is necessary to soak or steam a skull before the kinetics can be measured. The length of time and the temperature of the water may affect the movement.
5. Validity of the use of preserved materials as an index to the kinetic condition.
6. Effect of the use of preserved specimens as an index to movement.

In all the following experiments, measurements of kinetics were made

with the machine described by Fisher and Goodman (1955). Museum skulls were soaked in water of different temperatures. At least 24 hours elapsed between the successive measurements of skulls that had to be soaked more than once. Unless stated otherwise, skulls were uniformly soaked for one hour in water that was at 100 degrees F. when the skulls were placed in it.

Preserved materials were kept in a mixture of one gallon of 10 per cent formalin and one pint of glycerin. Before preservation, all muscles were removed from the head. Before measuring, the heads were soaked in cold water.

In all instances within a species the same heads were used for a complete experiment. Thus in Table 4, the same 52 heads of Canada Geese were measured when they were fresh and complete, fresh with muscles removed, fresh with muscles removed and ligaments cut, and when prepared as museum skulls. A different series of 20 heads was measured when fresh and when preserved. Changes indicated are ones that actually occurred and are not just what might be found by measuring two different series under the conditions stipulated.

Discussion of the Data

If the bony construction of the skull includes a "stop" for kinetic movement, measurements of museum skulls should produce consistent and reliable data. The data on a series of 30 cormorant skulls are presented in Table 1. Variation between the findings of two different observers indicates that no mechanical stop, other than perhaps the rigidity of the hinge, is operating. The significant difference results from different pressures applied by the observers.

Table 1

Degrees of Movement of the Fronto-nasal Hinge in Double-crested Cormorants

	No. specimens	Mean	Standard deviation	Range	Coeff. variation	
Observer 1	30	20.8±0.29	1.59	18–24	7.6	highly significantly
Observer 2	29	30.7±0.52	2.80	25–35	9.1	different

However, in the crow there is a definite bony stop. The orbital process of the quadrate has an enlarged, clapper-like end which presses against a papilla in the posteroventral part of the orbit (Fig. 1) when protraction (dorsal movement of the upper bill) is greatest. This may be observed in fresh heads. Table 2 shows relatively close agreement between the degrees of movement in fresh heads and in museum skulls of crows. It may be observed in Table 3 that in all the species studied there is a significant

change in apparent degrees of movement when fresh heads are prepared as museum skulls. Further, the coefficients of variation are greater for skull measurements than for any other measurements. These observations indicate that protraction in living birds may be halted by factors other than bony structures. Even in the crow, the special structure is at most a "final stop" as shown by the fact that fresh heads have a significantly smaller amount of movement.

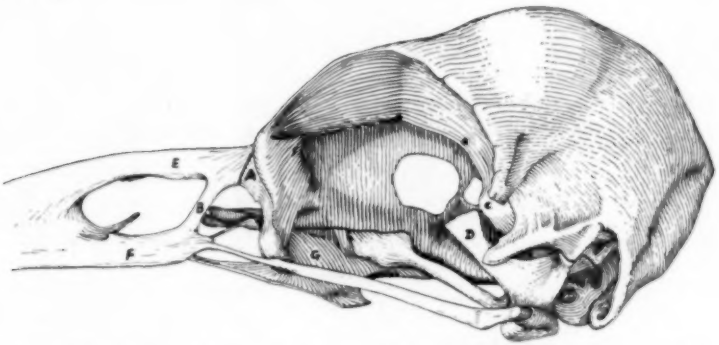

FIG. 1. Lateral view of the skull of an American Crow. A is the lacrimal bone ("retractor stop"); B, the nasal process of the maxillary; C, the "protractor stop" on the posterior wall of the orbit; D, the orbital process of the quadrate; E, the nasal bone; F, the maxillary bone; and G, the palatine bone.

TABLE 2

DEGREES OF MOVEMENT OF THE FRONTO-NASAL HINGE IN SEVENTEEN CROWS

	Mean	Standard deviation	Range	Coeff. variation	
Fresh heads: complete	16.9±0.38	1.57	14–19	9.3	
Museum skulls:					
soaked 1 hr. at 100° F.	19.0±0.62	2.57	14–24	13.5	increase 12.4%; $P<.01$
soaked 3 hrs. at 100° F.	20.1±0.76	3.12	10–26	15.5	increase over 1 hr. soaking 5.8%; $P>.10$
soaked 30 min. at 180° F.	21.2±0.75	3.09	12–29	14.7	increase over 1 hr. soaking 11.6%; $P=.05$

Bony structures that stop retraction seem to be more plentiful. This might be expected, for the upper bill is usually in the retracted position and maintenance of this position might cause considerable strain on the relatively small retractor muscles. With the several bony stops described below there is no muscular effort necessary, once the bill is retracted.

In the Canada Goose there may be found on the anterior tip of the base

FIG. 2. Lateral view of the area of the frontonasal hinge in *Balearica* to show the ("retractor stop").

of the lacrimal a tooth-like projection which fits into a notch in the posterodorsal part of the nasal process when the bill is retracted (Fig. 3 B). The fit between the "tooth" and the notch is close when the bill is fully retracted. Further, abnormal retraction results in a pull against the length of the bones in the hinge. Without the tooth and notch, abnormal retraction would cause a transverse, breaking force against the bones. The difference is important, because bones may withstand much more force exerted along their long axes than at right angles to these axes. Similar stops are present in the Lesser Scaup (*Aythya affinis*), Mallard (*Anas platyrhynchos*), Whistling Swan (*Cygnus columbianus*), and Hooded Merganser (*Lophodytes cucullatus*). It is not well developed in the latter.

In the cranes *Balearica* (Figs. 2, 3C), *Grus*, and *Anthropoides*, and in the Domestic Pigeon (*Columba livia*) a somewhat different retractor stop is found. In these birds the thin nasal process extending dorsoposteriorly to the hinge comes to rest on the dorsointernal edge of the lacrimal when retraction is complete. In *Corvus* (Fig. 1) the nasal process comes to rest partly on the anterodorsal corner of the lacrimal but primarily on the dorsal end of a much inflated bone closely applied to the anterior surface of the lacrimal.

Another source of variation in the measurement of kinetics in museum skulls may be found in the greater flexibility of skulls of young birds. Even casual study of skulls reveals the lesser ossification of the hinge in young birds. The Pekin Ducks may be used as an example. The series for which data are presented in Table 6 was composed of young ducks, because those were the ones primarily available. Five adults were measured; fresh, they averaged 24.6 degrees of movement; as skulls, the movement was 28.0 degrees. If these are compared to data in Table 6, it is seen that the measure-

FIG. 3. Dorsal views of the area of the frontonasal hinge in *Corvus* (A), *Branta* (B), and *Balearica* (C). See legend for Fig. 1.

ments of fresh specimens corresponded fairly closely to those of young ducks, but the measurements on skulls were lower.

Related to this variation is another which concerns the preparation of skulls. In Tables 4, 5, and 6 it is apparent that readings for museum skulls were always lower than for the same skulls when they were fresh but had all the muscles and ligaments removed. At first thought this does not seem logical; the only difference is the drying, "bugging," bleaching and/or degreasing to which the museum skulls have been subjected. However, it is apparent that these processes reduce the possible movement, either by affecting the articulations or the flexibility of the bones themselves. The effect may be brought about by removal of the organic materials.

It is of passing interest that mean movement as measured on skulls in

TABLE 3

INCREASES IN DEGREES OF MOVEMENT OF THE FRONTO-NASAL HINGE WHEN FRESH HEADS ARE PREPARED AS MUSEUM SKULLS

Canada Goose	4.3 degrees (19.4%)	$P < .01$
Mallard Duck	10.5 degrees (44.8%)	$P < .01$
Pekin Duck	7.8 degrees (31.2%)	$P < .01$
American Crow	2.1 degrees (12.4%)	$P < .01$

no instance showed a significant variation from mean movement as indicated by measurement of fresh heads from which the muscles had been removed (Tables 4, 5, and 6).

Since skulls must be soaked prior to measurement, the soaking may introduce other errors. Table 2 contains data from a few experiments on this factor. It seems evident that skulls must be soaked a uniform length of time for measurements to be accurate and comparable.

The experiments with Canada Geese (Table 4), Mallard Ducks (Table 5) and Pekin Ducks (Table 6) demonstrate a significant change when all the muscles are removed. The increase varies from 14 per cent in the Canada Goose to 49 per cent in the Mallard. One might expect some change as the result of removal of the retractor muscles which oppose protraction. But this seems to be something more. In a few fresh specimens all cranial muscles having a possible retractor function were cut across. The amount of movement did not increase significantly over that found in fresh, complete heads. It is thought that simply the bulk of the muscles is a limiting factor.

One might also believe, since the ligaments were still intact, that the limitations imposed by the ligaments prevented a clear-cut demonstration of muscular limitation. However, Tables 4, 5 and 6 contain data which show a significant change when all the ligaments are cut on these same heads. This increase over the movement found when just the muscles were removed ranges from 16 per cent in the Mallard to 28 and 33 per cent in the two series of Pekin Ducks.

There are perhaps eight or ten ligaments which may limit the movement. The diagram (Fig. 4) shows the position of some of these. In addition to these ligaments, the connective tissue in the ligamentous capsules surrounding the joints may be a limiting factor. It was not possible to test for the effectiveness of each individual ligament and joint capsule.

It seemed, from observations made during the measurement of heads in various stages of removal of parts, that the lacrimo-maxillary "ligament" (a broad band of fascia), the pterygo-palato-orbital ligament, and the vomero-orbital ligament were the most important limiting ligaments. Attention was centered on these and on the capsule about the articulation between the pterygoid bone and the basipterygoid process (Fig. 4).

A second series of Pekin Ducks (Table 6) was used to test the effects of successive removals of various ligaments. Data in this table indicate that removal of all ligaments shown on the diagram (Fig. 4) except the lacrimo-maxillary, pterygo-palato-orbital, and the vomero-orbital resulted in an increase of 5.2 degrees of movement (15.8 per cent).

When the lacrimo-maxillary ligament or fascia was cut, no demonstrable

TABLE 4 DEGREES OF MOVEMENT OF THE FRONTO-NASAL HINGE IN CANADA GEESE

		No. specimens	Mean	Standard deviation	Range	Coeff. variation	Percentage change	Probable significance of change
Fresh heads: complete		52	22.2±0.26	1.86	17-26	8.4		
	all muscles removed	52	25.3±0.32	2.34	19-32	9.2	increase 14.0	P<.01
	all ligaments cut	52	30.3±0.36	2.59	20-38	8.5	increase 19.8	P<.01
Skulls:	museum preparation	51	26.5±0.44	3.16	17-34	11.9	decrease 12.5	P<.01
Fresh heads: complete (within 8 hrs. of death)		20	21.6±0.45	2.03	18-29	9.4		
Preserved heads: muscles removed; ligaments intact		20	18.7±0.46	2.07	14-23	11.1	decrease 13.4	P<.01
Fresh heads: complete (about 24 hrs. after death)		20	20.8±0.47	2.10	20-32	10.0		

TABLE 5 DEGREES OF MOVEMENT OF THE FRONTO-NASAL HINGE IN MALLARD DUCKS

Fresh heads: complete		23	23.4±0.59	2.84	18-30	12.1		
	all muscles removed	23	34.9±0.66	3.15	28-42	9.0	increase 49.1	P<.01
	all ligaments cut	23	40.3±0.58	2.77	33-48	6.9	increase 15.5	P<.01
Skulls:	Museum preparation	21	33.9±0.71	3.20	23-40	9.4	decrease 15.9	P<.01

change occurred although tightening of this ligament may be seen when the bill is protracted by one's hand.

Removal of the capsule around the pterygoid-basipterygoid articulation increased the movement by 1.8 degrees ($P>.10$).

When the pterygo-palato-orbital and vomero-orbital ligaments were removed from the same specimens, the movement increased significantly by 3.8 degrees or 9.5 per cent.

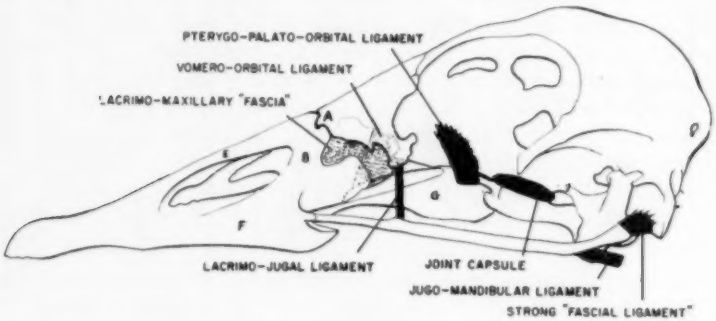

FIG. 4. Lateral view of the skull of a Canada Goose, showing the positions of some soft structures which limit kinetic movement.

The increases noted above, whether they were in absolute or percentage values, can not be construed as the actual extent of limitation caused by the parts removed. The sequence of removal undoubtedly plays a major role in determining these values. Had it been feasible to remove the muscles, ligaments and capsules in different sequences, the values might well have been different. What these increased movements do show is that all these structures are parts of the total mechanism that limits protraction.

THE CRITERIA FOR RELIABLE MEASUREMENT OF AVIAN JAW KINETICS

Knowing that all these soft and bony structures may restrict protraction, or retraction, it is obvious that no valid conclusions concerning the amount of movement can be based solely on measurements of museum skulls. Unless one has previously established for a species an index of relationship between measurements of fresh heads and of skulls, skulls cannot be used. (Note the variations between the species of waterfowl in Table 3 and variation with museum preparation, soaking, and age.)

Preservation of heads in formalin and glycerin and the subsequent soaking that is necessary prior to measurement reduce significantly the amount of movement (Table 4).

TABLE 6 DEGREES OF MOVEMENT OF THE FRONTO-NASAL HINGE IN YOUNG PEKIN DUCKS

	No. specimens	Mean	Standard deviation	Range	Coeff. variation	Percentage change	Probable significance of change
Fresh heads: complete	83	27.0±0.40	3.64	19-38	13.5		
all muscles removed	44	32.4±0.63	4.17	23-42	12.9	increase 20.0	P<.01
all ligaments cut	43	41.5±0.78	5.10	26-55	12.3	increase 28.1	P<.01
Skulls: museum preparation	20	33.0±1.33	5.97	21-48	18.1	decrease 20.5	P<.01
Fresh heads: complete	19	25.0±0.45	1.96	21-30	7.8		
all muscles removed	19	32.9±0.72	3.13	29-40	9.5	increase 31.6	P<.01
only lacrymo-maxillary, pterygo-palato-orbital, and vomero-orbital ligs. remain	19	38.1±0.73	3.20	30-45	8.4	increase 15.8	P<.01
lacrimo-maxillary ligament cut	17	38.0±1.03	4.26	30-46	11.2	no change	
pterygo-basipterygoid capsule removed	17	39.8±1.18	4.86	29-55	12.2	increase 4.7	P>.10
pterygo-palato-orbital and vomero-orbital ligs. cut	19	43.6±0.77	3.34	36-52	7.7	increase 9.5	P=.01
Skulls: museum preparation	19	32.8±1.23	5.36	22-42	16.3	decrease 24.7	P<.01

Fresh heads are thus the only satisfactory material for measurement of kinetics in birds. It is not always possible to obtain and measure these heads immediately after death. With the exception of a series of 20 Canada Geese, all fresh heads in this study were measured within eight hours of death. Coefficients of variation of these were not unduly high; they were no higher than the coefficient of variation for the series of Pekin Ducks which had just been killed. Amount of movement in the 20 geese that were measured 24 hours after death was not significantly different from that found in another series of 20 measured within eight hours of death. The only special treatment the "24-hour" skulls received was that they were refrigerated and that the stiffness was removed by protracting the bill several times before the measurements were made.

Series must have an adequate number of specimens in them. If one looks over the data presented in the tables, it becomes apparent that there is considerable variation of several kinds. Therefore, we can not study kinetics from measurements or dissections of one or a few specimens. Even with samples of 83 and 19 in Table 6 note that there is an apparently significant difference (27.0 ± 0.40 versus 25.0 ± 0.45) between the two series of fresh heads of Pekin Ducks!

Summary

The kinetics of the avian skull, defined as protraction and retraction of the upper bill, can be a source of valuable information on the evolution of the feeding mechanism and consequently on the evolution of the species. But accurate and consistent quantitative studies of kinetics must be made before conclusions are drawn.

This study has contributed the following information pertinent to the gathering of quantitative information and to the limitations on movement:

1. As just noted, there must be a sufficient number of specimens in a series for the results to have some statistical reliability.
2. Intact, fresh heads must be used; they may be measured as long as 24 hours after death.
3. Skulls prepared for museum collections do not permit reliable or consistent measurement; soaking, "bugging" or cooking, degreasing and bleaching these skulls give rise to great variability in kinetic movement.
4. Skulls may not even be used as an index to kinetics unless there has been established for a species a definite relationship between measurements on the skull and measurements on the complete, fresh head.
5. Heads preserved in formalin and glycerin show a decreased kinetic

movement which makes measurements of them incomparable with measurements of other materials.

6. Although some species, such as the American Crow, possess definite bony structures which stop protraction, most limitation is imposed by soft parts of the head. Retractor stops of bone are present in many species.
7. The entire mass of cranial muscles, including muscles not apparently connected with protraction or retraction, restrains movement.
8. Ligaments, as might be expected, are of major importance in circumscribing kinetic motion. The limitations set up by the vomero-orbital and pterygo-palato-orbital ligaments are noted.
9. Even joint capsules, particularly the one around the articulation between the pterygoid and the basipterygoid process, reduce and limit kinetic activity. The effect of this one capsule was measured.

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WINTER ROOSTS OF MARSH HAWKS AND SHORT-EARED OWLS IN CENTRAL MISSOURI

BY MILTON W. WELLER, I. C. ADAMS, JR., AND B. J. ROSE

THE GROUND ROOSTING HABIT of the Marsh Hawk (*Circus hudsonius*) and the Short-eared Owl (*Asio flammeus*) has been reported by numerous authors. A few have noted large winter concentrations in areas where small mammals were abundant. Stoddard (1931:209–210) stated that Marsh Hawks commonly roosted on the ground in Florida in two's and three's but were sometimes found in groups numbering 30 during periods of abundance of the cotton rat (*Sigmodon hispidus*). Snyder and Hope (1938) and Kirkpatrick and Conaway (1947) reported groups of up to 13 Short-eared Owls in Ontario and Indiana, respectively, in years of high levels in meadow mouse (*Microtus* spp.) populations.

We found a similar response to high mouse populations in central Missouri. In mid-February, 1952, eight Marsh Hawks were observed hunting over a field in the upland prairie region 12 miles east of Columbia. Later observations revealed a large number of Marsh Hawks and Short-eared Owls feeding and roosting there. Signs of great numbers of *Microtus ochrogaster* were evident; above-ground nests, runways, and dead mice were abundant. Reports by local farmers also gave evidence that the *Microtus* population was unusually high during the winter of 1951-1952.

Four adjoining fields were frequented by the birds. All were predominantly wheat stubble fields overgrown with common ragweed (*Ambrosia artemisaefolia*) to a height of two to three feet. Most of the fields were damp, a few having standing water in furrows and ditches. The four fields were within an area of less than one-half square mile. An intensive search of over five square miles revealed no other roosts.

By placing several observers at the edge of each field, an attempt was made to count the Marsh Hawks as they left the roosts in the morning. Counts of as many as 66 hawks were made during mid-March. Since not all took flight and there was some difficulty in counting, it was estimated that 80 to 90 hawks were roosting in these fields. Although both sexes were present, sex ratios could not be obtained because of the similarity of the plumage color of females and juvenile and second-winter males. Short-eared Owls were counted by flushing them from roosts during the day, 13 being the greatest number seen in one day.

ROOSTING BEHAVIOR

Hawks were not abundant in the roosting area during the day. Toward evening, they moved to the roosting fields from all directions, hunting as

they came. After hunting over the roosting areas, they finally dropped to the ground and remained there for the night. Hawks went to roost from five to 25 minutes after sunset. Their manner of settling into the roosts made the hawks and the roost inconspicuous; no great number of hawks was in view at one time. Roosting sites were on dry mounds, as shown by fecal droppings and groups of pellets. From the abundance of pellets at some roosting sites, it was inferred that hawks often returned to the same place nightly or that the site was preferred and used by many individuals.

In the morning, Marsh Hawks left the roost more gradually than they settled down in the evening, but when doing so, arose and departed in a straight line of flight. Some hawks were observed taking flight as much as 45 minutes after the departure of the first bird from the roost at about 10 minutes before sunrise. A few were flushed even later in the morning. Hawks were often observed preening on the ground on bright mornings. Rarely did they hunt over the roosting area in the morning, possibly because of the activity pattern of their prey. Calhoun (1945) and Fisher (1944. Unpublished data, Master's Thesis, University of Missouri) agree that while the major activity of *Microtus ochrogaster* comes several hours after sunset, there is a lesser peak of activity at sunset and a decrease in activity at sunrise. As shown by field sign and pellet analysis, *Microtus ochrogaster* was the dominant small mammal in the area and its diel activity rhythm probably affected the behavior of the hawks.

Local farmers reported that the hawks had been in the area since about late October. They remained until late March when they presumably migrated. No mass exodus was noted, but rather, a gradual diminution of their numbers. The Short-eared Owls were not observed after mid-March.

As shown by field sign, mouse populations in 1953 were very low in comparison with those in 1952. Only 13 hawks were seen. These were roosting in a field of a type similar to and four miles from the area used in the previous year. Although no satisfactory measurement of the mouse population was obtained, our observations seem to agree with those of Stoddard, who found that the abundance of Marsh Hawks was an index to the size of the rodent population. Further explanation for the shortage of hawks in 1953 may have been the mild winter which allowed them to winter farther north. None was observed in 1954 or 1955 but the severe drought conditions probably depressed the *Microtus* population.

Food Habits

Thousands of hawk pellets were found in 1952 but only 118 could be located in 1953. Two hundred of the pellets collected in 1952 and all those found in 1953 were analyzed. Leroy J. Korschgen, Food Habits Biologist,

of the Missouri Conservation Commission, gave valuable advice and assistance in the analysis of the pellets. The data for the two years are shown in Table 1. Because Marsh Hawk pellets contain little bone, they reflect the prey species taken but not the numbers (Errington, 1930). Therefore, only the frequency of occurrence of each prey species in the total number of pellets for each year is presented. Although *Microtus* was the major food taken during both seasons, there was an obvious decrease in the frequency during 1953. No detailed evaluation of this decrease can be made because of the absence of mouse population data. A comparative study of fluctuations in mouse populations and changes in the frequency of occurrence of mouse remains in hawk or owl pellets might be used to establish a simple technique for measuring mouse populations by analysis of pellets. Although other microtines made up only a small part of the prey, it is interesting, although not statistically significant, that the frequency of occurrence of southern bog lemmings (*Synaptomys*) decreased slightly in 1953. Blair (1948) found that *Microtus* and *Synaptomys* populations fluctuated synchronously in southern Michigan. Of significance is the increased predation on birds and other mammals resulting from the scarcity of mice. Although Marsh Hawks frequented the roosting areas and booming grounds of Prairie Chickens (*Tympanuchus cupido*), there was no evidence that chickens were preyed upon. The only game bird found was one Bobwhite Quail (*Colinus virginianus*). The remains of most songbirds could not be identified.

TABLE 1
FREQUENCY OF OCCURRENCE OF PREY SPECIES IN MARSH HAWK PELLETS

Prey Species	200 Pellets, 1952	118 Pellets, 1953
Microtus ochrogaster	95.0	74.6
Synaptomys cooperi	8.5	7.6
Sylvilagus floridanus	7.0	16.1
Unclassified birds	4.5	27.1
Peromyscus spp.	3.0	4.2
Unidentified snake	0.0	0.8

During 1952, as many as 13 Short-eared Owls utilized roosting areas near those of the Marsh Hawk sites. Owls showed a preference for areas with dense cover of panic-grass (*Panicum dichotomiflorum*) and poverty grass (*Aristida* sp.) less than one foot high. Their roosts were on drier sites than those of Marsh Hawks and commonly in a form in a tuft of grass. Feces, pellets, and feathers were found in these forms. In one such area, owls and hawks roosted together in a stubble field which contained a late summer's growth of panic-grass. Pellets of the two species could be distinguished by

associated feathers and by fecal remains: the feces of Short-eared Owls were black and string-like and those of Marsh Hawks were green and pellet-like. In addition, pellets found in forms and with an abundance of bone protruding from the hair were those of owls. Marsh Hawk pellets rarely contained more than a few teeth and jawbones enclosed in hair or feathers.

Data from 184 owl pellets are presented in Table 2 and demonstrate the availability of *Microtus* as food. The frequency of occurrence of *Microtus* in the diet of hawks and owls was similar but owls took fewer *Synaptomys*, deer mice (*Peromyscus*), and birds, and no rabbits.

TABLE 2

FREQUENCY OF OCCURENCE OF PREY SPECIES IN 184 SHORT-EARED OWL PELLETS COLLECTED IN 1952

Microtus ochrogaster	95.7
Synaptomys cooperi	3.3
Unclassified birds	2.7
Peromyscus spp.	1.1
Grasshopper	0.5

During the course of the 1952 observations, five dead Marsh Hawks were found in one roosting area. At the site of one, killed after a light snow, the lack of mammal tracks led to the conclusion that a Horned Owl (*Bubo virginianus*) was responsible for the predation. A Horned Owl roost on a deserted farm site 200 yards from the scene of the kill was examined. Among the 27 owl pellets collected, 25 contained mice, one contained chicken feathers, and one contained the upper mandible and some wing bones of a Marsh Hawk. This unusual and interesting prey of the Horned Owl presents further evidence of the importance of availability in predator food selection.

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NOTES ON THE MOLTS AND PLUMAGES OF THE SPARROW HAWK

BY KENNETH C. PARKES

EXAMINATION of the Carnegie Museum's series of 126 specimens of the North American Sparrow Hawk, *Falco sparverius sparverius* Linnaeus, has shown that some recent authors have been confused about certain of the molts and plumages of this little falcon. As is well known, individual variation in color and pattern in this species is so marked that the selection of characters for criteria of age and of geographic variation must be made with great caution. This variability shows its extreme development in the rectrix pattern of males, no two birds being exactly alike in this respect.

Bond (1943), in an otherwise excellent treatment of geographic variation in the Sparrow Hawks of western North America, has made several statements concerning molts and plumages that call for comment, especially as some are in direct contradiction to Bent (1938) and other authorities. On p. 174 Bond states "I can see no evidence that any fall molt of the young takes place. All changes in appearance are attributed to wear and fading. Immature specimens are not always certainly distinguishable even in fresh plumage." Bond then lists several "useful criteria of immaturity," ending with the sentence "Immature females are much more difficult to distinguish than immature males." This is the only one of his statements that I can endorse. Bond also presents a bar graph which purports to illustrate his statement that "First-year birds disappear rapidly after reaching a peak of about two-thirds of the population in August." Bond would have us believe that young Sparrow Hawks suffer a 75 per cent mortality (i.e., from two-thirds down to one-third of the total population) between August and November, a rate which seems excessive for a predator which "has not been reported as a major item in the diet" of any other predator (Clay, 1953:131). Actually, as I shall show, his graph of the "disappearance" of first-year birds is nothing but a representation of the schedule of the post-juvenal molt which Bond claims is non-existent.

Bent (1938:112) states of the young Sparrow Hawk ". . . early in fall changes begin to take place, by fading and by a gradual molt of the body plumage, during September and October; by midwinter great progress has been made toward maturity." This coincides exactly with my own findings; note how the progress of the molt corresponds with Bond's "disappearance" of first-year birds.

Criteria of Immaturity in Males

As to the actual criteria for recognizing juvenile birds, Bent apparently

based his rather detailed description on only a single specimen of either sex. Many of the plumage characters he ascribes to young birds are merely those of individual variation. To take these up in order, Bent claims that the young male has "only a hidden trace of the rufous crown patch and . . . larger black spots on the [wing] coverts than in the adult." Neither of these conditions is a character of immaturity. The rufous crown patch varies in our juvenile males from about one-fourth (reference specimen 36146, Malheur Co., Oregon) to about three-fourths (4380, Sheep Creek, Wyoming) of the entire crown area. The Oregon specimen mentioned has heavy black spotting on the wing coverts, while no. 114114, from Marathon, Texas, has these feathers almost immaculate. The series shows all stages of intermediacy in these two characters.

The great variation in the tail pattern of males, referred to earlier, renders meaningless Bent's description of a supposed pattern typical for immature birds. His mention of a single color for the underparts ("pinkish buff") is also without significance, since the color of this portion of the young bird may vary greatly. Specimen no. 36146 (Malheur Co., Oregon) has the breast feathers of a color between the Vinaceous Cinnamon and Orange Cinnamon of Ridgway (1912), while in no. 126043 (Alpine, Arizona) this area is nearly white, though the plumage is fresh and unbleached. There is no correlation between the color of the underparts and geographic distribution among these juvenile specimens of *sparverius*.

By far the best criterion for recognizing juvenile males as such is the heavy marking of the underparts. Only a few adult males exhibit any streaks or spots on the upper breast; this area in fall immature birds is invariably marked with longitudinal black streaks which widen into broad spots along the flanks. Even those few adults which retain some spotting on the chest seldom if ever match the juvenile birds in this respect. Such spotted birds may account for the supposed worn spring immature birds described by Bond (1943:175). Some exceptional individuals may actually retain some of the spotted feathers of the chest, but these normally disappear in the ordinary post-juvenal molt, as described beyond.

Another excellent character for recognition of young male Sparrow Hawks is the more extensive black barring of the dorsum. In adult males the anterior one-third (and sometimes more) of the scapular-interscapular area is immaculate; in juvenile birds the bars extend almost to the posterior edge of the gray of the crown. In most specimens examined, the post-juvenal molt of these dorsal feathers occurred later than that of the ventral plumage, allowing the dorsal pattern to be used as a criterion of immaturity for a longer period.

In juvenile males the light tips of the rectrices are usually washed with

a pinkish buff color, although this may be quite pale on the lateral pairs. In adults these tips are either white or gray. There is occasionally a light buffy wash, but the tips of the central pair of rectrices are apparently always gray.

Friedmann (1950:724) and others have indicated that young males usually exhibit dark shafts on the crown feathers. This statement is true, but must be somewhat modified. Some adult males may have well-marked shaft-streaks in the blue-gray areas of the head, especially toward the forehead (reference specimen 12063, Cochise, Arizona). However the brown crown patch of adults is seldom invaded by these shaft-streaks, while in young birds the brown crown feathers have well-marked gray centers.

The material I have examined does not confirm Clay's statement (1953: 130) that the nuchal region which resembles a pair of ocelli or "false eyes" is whiter in young birds than in adults. The pigmentation of this area in *sparverius* appears to be a matter of individual variation, although it is subject to geographic variation in some of the southern subspecies.

The post-juvenal molt of the body feathers in the male Sparrow Hawk takes place primarily in September and October, as amply illustrated by Carnegie Museum specimens. Such molting birds are instantly recognizable in a tray of specimens by the mottled appearance of the chest region. The streaked feathers, usually quite bleached by the time of molt, are replaced by immaculate feathers whose bright color contrasts plainly with the juvenal plumage. A specimen taken at Kenton, Oklahoma, September 22, 1932, (no. 113229) is molting the interscapular feathers, replacing barred with unbarred feathers in the anterior portion of this area. The shaft-streaks of the crown are also a short-lived criterion of immaturity, as illustrated by two specimens which have almost finished the post-juvenal crown molt; no. 4847 taken in Coahuila, Mexico, October 31, 1899, and no. 122283 from Santa Clara, Utah, October 23, 1937. Completion of the molt of these contour feathers leaves the color of the tips of the rectrices as the best indication of age by late fall and winter. This character, of course, is obscured by wear and fading, but this in itself is a clue to the age of a given specimen, since the tails of birds of the year are often quite worn by midwinter while those of adults may be relatively fresh.

Criteria of Immaturity in Females

As mentioned previously, recognition of immaturity in Sparrow Hawks is far more difficult in females than in males. There are ten female Sparrow Hawks in the Carnegie Museum collection which are either obviously young birds (fledglings) or have been marked "juv." or "imm." by the collector. These have been used as a standard to try to determine which characteristics

are held in common by young birds and not by adults. Unfortunately none of the three major criteria of immaturity in males — streaking of the chest, extensive dorsal barring and brownish tail-tips — applies to females. The color of the ventral streaks of females of all ages is so variable that I am unable to verify the statements of Bent (1938:112) and Friedmann (1950: 724) to the effect that these streaks are darker in young birds. Bent's statement that the ventral streaks of adults are narrower than those of juveniles is, on the average, true, but variation in this character is so great as to make it undependable as a primary criterion of immaturity.

I have found two characters which appear in most of the young birds, and are possibly diagnostic of immaturity, although not certainly so. The tails of all female Sparrow Hawks are brown, heavily barred with black. Since the tail-tip in unworn birds is brown, the distal black bar across the rectrices may be considered as a subterminal band. In almost all of the young birds examined, this subterminal band is broader than the anterior black bands only, if at all, on the central pair of rectrices. On the remaining rectrices there is no difference in the width of the subterminal and adjacent black bands. In adults, on the other hand, the subterminal band is decidedly wider than the remaining bands on the tail (except, usually, on the outermost pair of rectrices, where all of the bands are much reduced). There is much individual variation in the width of these tail bands, but in adults with wide bands the subterminal one is particularly wide, while in those with reduced tail bands the subterminal one may be quite narrow, but always wider than the adjacent ones.

The crowns of all immature female birds examined bore heavy shaft-streaks, and the gray and brown areas were poorly defined and somewhat blended. In many adult birds the two colors of the crown are bright and clearly defined, with little or no shaft-streaking. However, some adult specimens do approach the young birds in this crown character. One of the specimens examined, from Lake Chapala, Jalisco, was just beginning the post-juvenal crown molt when collected on November 11, 1899. I hesitate to make any generalization from this single specimen to the effect that the post-juvenal molt is later in females than in males.

The Lake Chapala specimen just cited is also beginning to replace the barred feathers of the interscapular region. Comparison of the old and new feather refutes Bent's belief that the black bars are relatively broader in young birds (Bent, 1938:112).

Very young Sparrow Hawks have a rather silky sheen which is quite characteristic of their plumage, but which quickly wears away. It is of little or no use as a criterion of first-year birds, since it disappears while the birds are manifestly young by several other criteria. I am unable to

detect any special consistency of the breast feathers as described by Bond (1943:174–175), and Bond admits that this supposed character of immaturity disappears with wear.

Many of the above conclusions concerning the juvenal plumage and post-juvenal molt of Sparrow Hawks conform with the findings published many years ago by Mearns (1892). Although Mearns' paper is listed in Bond's bibliography, Bond apparently consulted only the taxonomic portion, since he cites it only in connection with Mearns' description of the races *deserticolus* and *peninsularis*.

Plumage Changes in Adults

I have little to add to our knowledge of the molts and plumages of the adult Sparrow Hawk. Bent (1938:112) stated "I believe that the full perfection of plumage is not acquired until the bird is two years old, or more. The oldest males have the least spotting on the scapulars, a clear white or cinnamon breast, with only a few round black spots on the flanks, and the most rufous in the tail; probably successive annual molts are required to reach this perfection." I have already indicated my belief that there is no correlation between age and the color pattern of the tail. That this "perfection of the plumage" theory does not hold for other parts of the bird as well is indicated by specimen no. 131283, taken August 10, 1946, at Entrance, Alberta. This bird is an adult male beginning its post-nuptial molt. On the posterior two-thirds of the interscapular area many new heavily-barred feathers are replacing unbarred old ones, indicating that this particular adult is reversing the trend postulated by Bent. As in all adult males, both the old and the new feathers in the anterior one-third of the scapular region of no. 131283 are unbarred.

Summary

1. In spite of assertions to the contrary in the literature, *Falco sparverius sparverius* has a post-juvenal body molt. This occurs mostly in September and October, at least in males.
2. Certain characters which have been proposed as age criteria by various authors do not appear to have any significance in this respect. These include the size of the rufous crown patch, amount of spotting on the wing coverts of males, tail pattern of males, ground color of underparts, ground color of the ocelli of the nuchal region, width of dorsal bars of females, and consistency of breast feathers.
3. Immature males may be recognized by a combination of several characters, including spotting and streaking of the breast, barring of the anterior one-third of the scapular-interscapular region, brownish tips to rectrices, and dark gray shaft-streaks in the brown crown patch.

4. All of these characters except that of the tail-tip normally disappear during the post-juvenal molt. Young males in late winter or early spring may still be recognizable by the relatively greater wear of their rectrices.
5. Recognition of immature females is difficult. Two suggested criteria are the lack of a well-defined subterminal band on the tail and a crown with heavy shaft-streaking and poorly-defined brown and gray areas.
6. Adult males do not necessarily become less barred or spotted with successive annual molts.

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NOTES ON FIELD IDENTIFICATION AND COMPARATIVE BEHAVIOR OF SHRIKES IN WINTER

BY DALE A. ZIMMERMAN

For the second year in succession bird observers in Ohio and Michigan have reported numerous Northern or Gray Shrikes *(Lanius excubitor)*. In Michigan most winter shrikes are doubtless of that species, but the Loggerhead Shrike (*Lanius ludovicianus*) has been collected in late fall and winter in Monroe, Wayne, and Lapeer counties in the southern one-third of the state. Although unquestionably authentic winter records of Loggerheads have been published (Van Tyne, 1940:35 and Wood, 1951:359), some Michigan observers continue to assume that any shrike seen in that state in winter "has to be" a Gray Shrike.

Dr. Milton B. Trautman informs me that Ohioans in contact with nature clubs have learned that the Loggerhead is supposed to be the only shrike wintering in Ohio, except, possibly, along the Lake Erie shore, and that these observers have automatically considered most wintering shrikes to be of that species prior to the recent Gray Shrike invasions. In the Ohio State Museum and the University of Michigan Museum of Zoology there are 14 late fall and winter shrike specimens from Ohio: seven of these are Loggerheads, seven are Gray Shrikes. Both species have been collected as far south as Perry and Franklin counties in central Ohio.

Obviously, identifications of winter shrikes in this region based on seasonal or geographic probability are valueless.

Field Identification

Field identification is often difficult--particularly for persons who are not familiar with both species in life. Misleading, incomplete accounts in the popular bird guides make the problem appear simpler than it is.

Immature Gray Shrikes are washed with shades of brown and are so heavily barred that their identification is easy. The Loggerhead, except for juveniles in summer, is always a gray bird. Unless otherwise stated, the following remarks refer to adults.

Breast vermiculations.—These may be present on both species. Those of the Gray Shrike are narrow and sharply defined, while those of the Loggerhead are wider and less distinct (see Figure 1). Very heavily marked Gray Shrikes can be safely identified on the basis of vermiculations alone if the observer knows the limits of variation in these markings. In the field, however, many adult Gray Shrikes, particularly as their plumage becomes soiled or worn, do not show striking vermiculations. Some even appear clear-breasted. I have found that vermiculations clearly evident through a 20X

telescope were frequently invisible through coated 8X and 12X binoculars. The bars on some fall and winter female Loggerheads are remarkably distinct and may be easily seen.

Bill color.—This character is of less diagnostic value than is indicated in most bird guides, for both species may have the base of the bill light-colored in fall and early winter. The pale area is more restricted on the Logger-

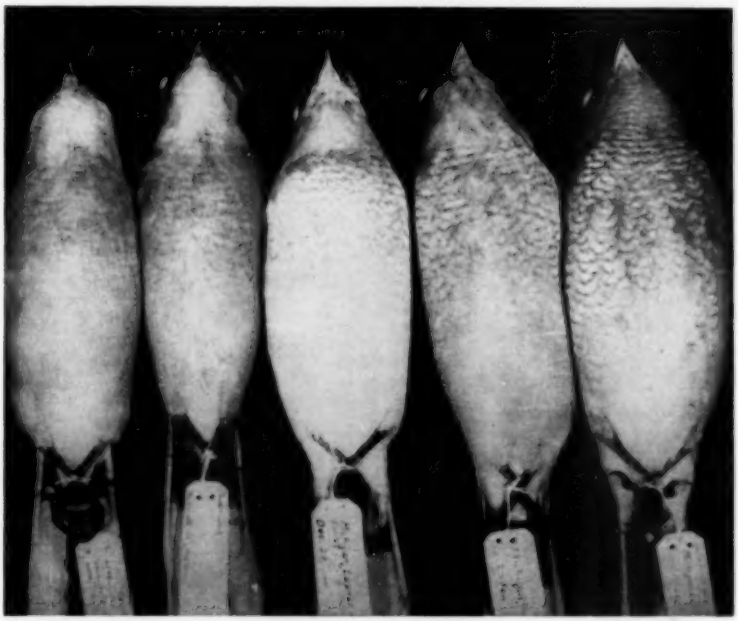

FIG. 1. Left to right: 2 female Loggerhead Shrikes; adult male Gray, adult female Gray, and immature male Gray Shrikes showing variation in extent and types of vermiculations.

head's bill, but is visible at distances of 40 to 50 feet in dull light through 7X binoculars. It is confined to the basal part of the lower mandible. In the Gray Shrike the basal quarter or one-third of one or both mandibles is light-colored—but only in fall and early winter. The bill becomes *entirely* black toward spring—sometimes as early as mid-March.

Facial feathering.—The nasal tufts and narrow strip of feathers at the base of the upper mandible are black in most Loggerheads, though in five of 18 female specimens of *L. ludovicianus migrans* examined, the latter region is gray like the rest of the forehead. In the Gray Shrike these feathers are

never dark and are nearly always noticeably *white or whitish, contrasting with the darker gray of the forehead and crown.* They are most conspicuous in a full-face view of the bird. ("Squeaking" will often hold the bird's attention long enough for the markings to be seen.) I examined one Loggerhead Shrike that showed whitish feathers at the base of the culmen, but the nasal tufts of that bird were black.

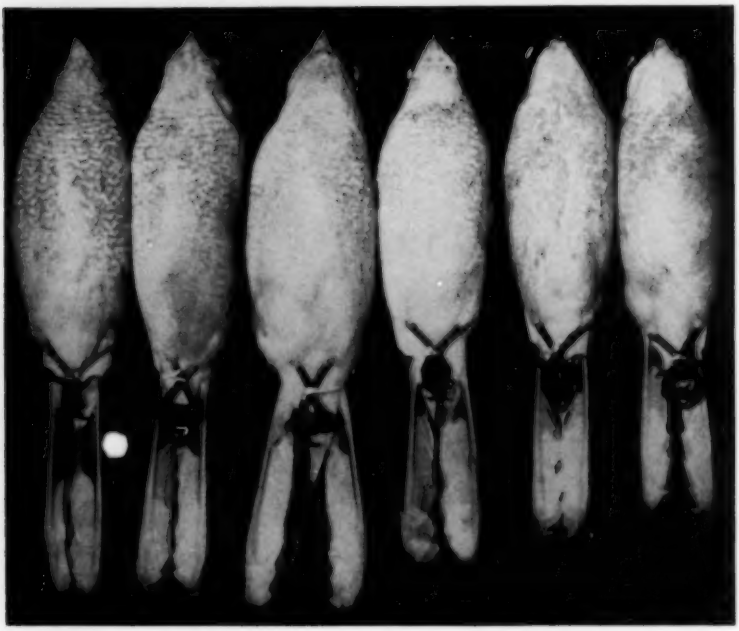

FIG. 2. Six winter shrike specimens showing size differences. Some allowance must be made for differences in make-up of skins, but specimens 1, 4, and 5 (counting from the left) were prepared by the author. Left to right: immature male Gray, adult female Gray, adult male Gray, adult male Gray, male Loggerhead, female Loggerhead.

The mask of the Loggerhead is wide, the anterior portion of its upper margin reaching, in most birds, from the top of the eye to the base of the culmen. Thus the lores and nasal tufts are entirely or largely black. In the Gray Shrike the loral portion of the mask is narrower, its upper margin extending downward from the top of the eye to below the middle of the upper mandible. (Some female Loggerheads have similarly restricted masks but do not show the whitish nasal tufts mentioned above.) Few Michigan Gray Shrike speci-

mens, and those only adult males, show well-defined, complete black masks. Some males (probably second-year birds) have the black of the lores flecked with gray which destroys the continuous pattern of the mask. Still other males (including brown first-year birds) and all females have almost no black in the lores, this color being confined to the postocular portion of the mask (except in the very brown first-year females, in which *all* black is replaced by brown). This "broken" mask effect is a useful field mark. A shrike with much white or gray in the lores and with *conspicuous* light feathers at the base of the upper mandible is certainly a Gray.

At close range another helpful mark, absent in the Loggerhead, is the small white spot below the eye of many Gray Shrikes (better developed in females than in males). Sometimes this spot is joined with the gray of the lores (see Fig. 4).

Discussion of Field Characters and Characteristics

As indicated above an early winter shrike with breast vermiculations and pale-based bill, or a spring bird with apparently clear breast and totally black bill might represent either species. Furthermore, anyone who has studied a shrike perched in the distance or on an overhead wire, knows that it is difficult to be certain of the lower forehead coloration. Fortunately, there are a few additional points, which, while differences in degree only, are useful if used in conjunction with some of the characteristics already discussed. It must be emphasized, however, that a positive identification could not be based on their use alone.

The Gray Shrike is a larger, longer bird than the Loggerhead (Fig. 2), but there is considerable individual variation. Its dorsal plumage is more silvery-gray, contrasting more with the black mask and less with the white scapulars than in the darker-backed Loggerhead. *Some* Grays have very white rumps, whereas *most* Loggerheads in this region have rather dark gray rumps. More important, *the Gray Shrike's bill is longer, heavier, and more strongly hooked than the Loggerhead's, and its head appears longer and larger, in proportion to body size* (Fig. 3). These head and bill differences are very impressive to observers who are familiar with both species. The Loggerhead's stubby bill is a relatively inconspicuous part of the bird. That of the Gray Shrike is noticeable at great distances, even in flying birds.

Voice.—In my experience Gray Shrikes are far more vociferous than Loggerheads. They frequently indulge in chattering, squeaking, mimicry, and even prolonged thrasher-like singing. True singing, while sometimes heard in October and November, seems to become more frequent after mid-January. We need detailed information on the vocal habits of both species.

Behavior.—My field experience with winter shrikes in the northern states

has been largely confined to *Lanius excubitor*. Dr. Milton B. Trautman, who has had considerable experience with wintering Loggerheads in Ohio, has generously placed at my disposal important information from his observations on shrikes in that state. In the following account I make frequent reference to his recent letters to me (February 18 and 23, and March 13, 1955).

Several observers have noted that the Gray Shrike's flight often seems more slow and deliberate than that of the Loggerhead. This difference may be more apparent than real, however, for Bent (1950:120) called the Gray

FIG. 3. Adult male Gray (right) and Loggerhead Shrikes (specimens 4 and 5 of Fig. 2), showing differences in width of mask and size of bill. (The bill color is considerably darker than that in living birds.

Shrike a "fairly swift flier," and mentioned Rathbun's (1934:24) account of clocking with an automobile a bird (of the northwestern race, *L. excubitor invictus*) at 32 to 42 and (briefly) 45 miles per hour on a windless day.

The Loggerhead seldom perches more than 25 feet above the ground, whereas the Gray Shrike usually chooses a tall tree-top or high wire for a hunting perch—frequently flying directly from one perch to another without dropping near the ground as the Loggerhead ordinarily does. The high, undulating type of flight is common to both species, but when Miller (1931: 222) states that it "is performed higher above the ground, often as high as twenty feet . . . " he undoubtedly refers only to *L. ludovicianus*. The Gray Shrike

frequently bounds through the air at tree-top level, and sometimes 75 to 100 feet above ground.

Miller (*op. cit.*:211) also writes that hovering "frequently is observed" in Loggerhead Shrikes. I have noticed it far more often in the Gray, and there is frequent mention of it in the literature pertaining to that species. Trautman writes that this bird "habitually stops and flutters in a stationary position in mid air, as does the Sparrow Hawk *(Falco sparverius)*." He adds that he clocked one for over two minutes, and that he has never noticed hovering "to be of more than momentary duration in the Loggerhead."

The Gray Shrike seems to bob its tail more frequently and energetically than does the Loggerhead, and sometimes it indulges in startling behavior unlike any reported, to my knowledge, for the Loggerhead. Trautman writes about a singing male Gray Shrike observed on South Bass Island, Ohio, February 23, 1955:

> When I first saw the shrike it was perched in the top of a small tree, about 25 feet from the ground, from which perch it sang persistently for over five minutes, after which I left it. Returning later I found the bird near where I had first seen it. Approaching closer I saw the bird doing an amazing thing. It was in the top of a wide branching tree, hopping rapidly from one branch to another, then quickly changing direction and hopping to another branch. It seemed to do a lot of unnecessary bobbing and turning. As it hopped about it sang its lovely phrases, sometimes alternating with cat-calls. I have never seen a similar behavior in any other bird.

I observed nearly identical actions in an immature Gray Shrike near Mt. Clemens, Michigan, on January 31, 1954. The latter bird preceded his antics (performed in the top of a 40-foot elm) with 10 or 12 high-pitched, squealing, sapsucker-like notes.

Near Imlay City, Michigan, December 5, 1954, I watched a subadult Gray Shrike fly from its perch on a roadside wire to a tree near a chicken yard where numerous House Sparrows *(Passer domesticus)* were noisily feeding on the ground. Apparently attempting to startle the sparrows into flight, the shrike began excitedly jumping about—from branch to branch, from the tree to an adjacent wire fence or to low telephone wires and back to the tree again—all the while flopping its tail and repeatedly spreading its tail and wings. As I followed the rapid action (with difficulty) through the telescope I was continually reminded of a Mockingbird's *(Mimus polyglottos)* "wing-flashing." After nearly a full minute of this behavior one sparrow flew upward across the open farmyard, with the shrike following. The sparrow managed to keep above its pursuer and at a point several hundred feet above ground, where both birds appeared as mere specks, the shrike gave up the chase.

In the same region, on March 28, 1954, I watched an adult Gray Shrike perched on a diagonal support cable leading from a tall roadside utility pole

to the ground. Fluttering its wings like a young bird about to be fed, the shrike slowly moved sideways down the cable until within a few feet of the ground, uttering high *p'seet* notes which I could barely distinguish from those

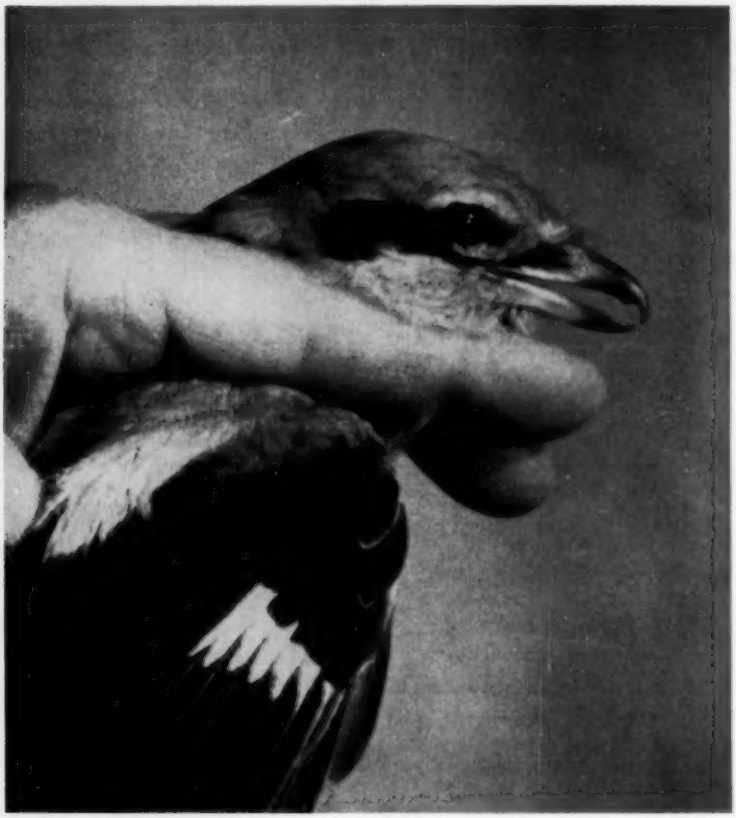

FIG. 4. Gray Shrike (? female), Arcadia Township, Lapeer County, Michigan, December 17, 1953. Note the interrupted mask and the extent of the light area on the lower mandible. Photograph by L. M. and L. P. Zimmerman.

of several Horned Larks *(Eremophila alpestris)* that were calling from the adjacent field. A few minutes later it flew to the high wires above and began preening. It was heedless of my presence and remained within 15 feet of the road while two or three automobiles roared past.

Miller (*op. cit.*:144) writes: "Apparently *L. excubitor* is less fixed in its winter habitat than *L. ludovicianus*, for it seems to wander about in response to varying local conditions of food and weather." However, both species seem to inhabit definite territories in winter. Several times from December, 1953, through March, 1954, my family and I observed what we believed to be the same Gray Shrikes in certain localities in Lapeer County, Michigan. Although these individuals had favorite hunting perches their territories were large, thus making it difficult to find a particular bird on a given day.

Mrs. Alice D. Miller banded an adult, male-plumaged Gray Shrike at her Leonard, Michigan, station on November 3, 1954, and retrapped the same bird there February 3, 1955. An adult that I banded November 29, 1953, in Lapeer County, was possibly the same banded individual I saw 300 yards south of the banding station on March 21, 1954.

Trautman observed some Ohio Gray Shrikes that seemed to hunt over great circular routes. He "followed one for a distance of 2½ miles during a ½ hour period and it still had not completed its circle." The Loggerhead, according to that observer, is "quite sedentary in winter and the same bird can be seen day after day about its [osage orange] hedge."

Trautman informs me that the Gray Shrike "apparently cannot compete with" the Sparrow Hawk; that when a Gray Shrike enters the winter territory of a Sparrow Hawk it is driven out, and when the falcon enters a Gray Shrike's territory the shrike immediately leaves. His observations indicate that there is no such competition between Sparrow Hawks and Loggerhead Shrikes; he has seen those two species sharing the same hunting territory.

Miller (*op. cit.*:213) stated that "there appear to be more records of *L. excubitor* carrying food in the feet than there are of *L. ludovicianus*." In his extensive field work with western races of the Loggerhead Shrike he never saw a bird carry food in its feet (though he pointed out that the action did occur at least rarely in that species). I have several times seen Gray Shrikes carrying birds or mice for distances of 100 feet to a quarter of a mile; in every case prey was carried in the feet. I have never seen the Loggerhead attempt to carry vertebrate prey. Floyd (1928:46) summarized reports by 23 eastern observers which show that the Gray Shrike may use either its bill or feet in this connection: 13 observers reported the use of bill only, seven observed the use of feet only, and three noted the use of both.

ACKNOWLEDGMENTS

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A NEW RACE OF OLIVACEOUS WOODCREEPER FROM MÉXICO

BY GEORGE MIKSCH SUTTON

RECENTLY I have had occasion to re-identify the 18 specimens of Olivaceous Woodcreeper *(Sittasomus griseicapillus)* in my collection. All of these are from México, three from Veracruz, two from Chiapas, one from San Luis Potosí, and 12 from the Gómez Farías region of southwestern Tamaulipas. The darkest of the series, both above and below, are those from Veracruz (two males and a female from the Río Atoyac, four miles north of Potrero). These we may consider representative of the race *S. g. sylvioides* Lafresnaye, the type locality of that form having been restricted by Bangs and Peters (1928. *Bull. Mus. Comp. Zool.*, 68:392) to the State of Veracruz, México. The female is slightly paler than the males, especially on the under parts.

The two Chiapas specimens, males from the vicinity of Monserrate, are much like the Veracruz specimens just discussed except that they are longer-billed and a trifle paler. Bill-length in the Veracruz males is 13.5, 14.0 mm.; in the Chiapas males, 15.5, 15.5. Wing-length in the Veracruz males is, respectively, 81, 81; in the Chiapas males, 79, 80; tail-length, again respectively, is 76, 76; 78, 81. In the latter Veracruz specimen the tail-spine is obviously worn, so that measurement is of doubtful value.

Tail-length in *Sittasomus griseicapillus* varies a great deal, and I am not sure that averaging and comparing tail measurements serves any useful end. In some specimens before me the terminal tail-spine is wholly absent as a result of wear; in others it is short *or missing altogether* even though the feathers are unworn. A male taken along the Río Sabinas, near Gómez Farías, Tamaulipas, on March 10, 1949, by William B. Heed, is quite fresh-plumaged and unworn, yet the long middle rectrices are virtually without spine at the tip, and the actual tail-tip is not the end of the longest feather's rachis but the most distal part of that feather's inner web. Some southwestern Tamaulipas specimens have extraordinarily long tail-spines. A male taken by J. H. Poppy and E. K. Miller at the Rancho del Cielo, near Gómez Farías, on July 28, 1948, has a tail length of 87 mm., the terminal spine on the left middle rectrix being fully 12 mm. long. Length of the unworn tail-spine, and tail-length itself, may be correlated with age. The longest-spined Mexican birds I have handled are from Tamaulipas. I have not recently examined specimens from south of México.

My Veracruz and Chiapas specimens are dark, as a group, in comparison with the 12 Tamaulipas specimens (11 males, one female) and one San Luis

Potosí specimen (female from Mais) in my series. When I first compared all these birds I noticed that some Tamaulipas males were unusually long-tailed, but I dismissed from my mind the possibility that they might represent the race *S. g. jaliscensis* Nelson, because that race was said to be slightly darker on the under parts than *sylvioides* (see Nelson, 1900. *Auk*, 17:265; and Ridgway, 1911. *Bull. U.S. Nat. Mus.*, 50, pt. 5: 283). Since all of my Tamaulipas and San Luis Potosí specimens were too pale below for *sylvioides*, they would obviously be too pale for *jaliscensis*.

Dr. Herbert Friedmann kindly lent me the type of *jaliscensis* as well as four specimens (one male and three females) of "*sylvioides*" collected by Nelson and Goldman at Metlaltoyuca, Puebla, in February, 1898. With this helpful material at hand, I have gone over my series again. The four Puebla birds are a little paler than my Veracruz and Chiapas specimens. Wetmore used this same Puebla series in identifying as *sylvioides* specimens recently collected by Carriker in Veracruz (Cerro de Tuxtla and Volcán San Martín). He commented (1943. *Proc. U.S. Nat. Mus.*, 93:278) that the Puebla birds were "slightly paler than birds from Veracruz." The Puebla specimens do not appear to have undergone post-mortem fading, though such "foxing" is surely to be borne in mind when we are dealing with dendrocolaptids.

As for the type of *jaliscensis*, a male taken March 17, 1897, at San Sebastian, Jalisco, we must not discount the possibility that, with the passing of the years, the specimen has faded. In any event, its under parts certainly do not impress me as being "darker grayish brown" (Nelson, *loc. cit.*) than those of Veracruz and Chiapas *sylvioides* at hand. It is, however, definitely darker below than all the Tamaulipas and San Luis Potosí specimens before me, and it is also longer-billed and slightly longer-tailed. Confirming Nelson's tail-measurement (89 mm.) of his type of *jaliscensis* is impossible, for part of the tail is now missing. In none of my Tamaulipas males does tail length reach 89 mm., though in two specimens it reaches 87 mm.

Since the Tamaulipas and San Luis Potosí birds are neither *sylvioides* nor *jaliscensis*, and since no name seems to be available for them, I suggest that they be called

Sittasomus griseicapillus harrisoni new subspecies.

Type: From Rancho del Cielo, five miles northwest of Gómez Farías, Tamaulipas, México; 3300 feet. Adult male, no. 12893, Sutton Collection, collected March 30, 1949, by Paul S. Martin (original number 172). Type at the Museum of Zoology, University of Oklahoma, Norman, Oklahoma.

Diagnosis: Similar to *S. g. sylvioides* Lafresnaye as known from Veracruz and Chiapas, but paler, especially on the chin, throat, and chest, where the gray tends to be slightly more ashy and less olivaceous than in *sylvioides*. Similar to *S. g. jaliscensis* Nelson of Jalisco, but paler below. In size, inter-

mediate between these two races, but nearer *jaliscensis*, especially in wing- and tail-length; in color not intermediate, but paler than either.

Range: So far as is known, the foothill country of southwestern Tamaulipas and eastern San Luis Potosí, intergrading with *sylvioides* in Puebla. Areas of intergradation with *jaliscensis* are not known.

Description of Type: Chin, throat, sides of head, sides of neck, and breast Grayish Olive, passing through Citrine Drab on the belly to Tawny on the under tail coverts and to Cinnamon Brown on the under side of the tail. Whole top of head and hind neck Dark Olive Gray, passing through Olive Brown on the upper back, wing coverts, and fore part of the primaries (in the folded wing) to bright Russet on the lower back, rump, tertials, upper tail coverts, and upper side of the tail. Inner webs of primaries dark Mummy Brown at their tips. Capitalized words here used are from Ridgway's "Color Standards and Nomenclature," 1912.

Measurements of Type: wing, 80 mm.; tail, 80; culmen, 13.0; tarsus, 17.0. Unworn spine at tip of middle rectrices, 7 mm.

Remarks: The 11 male Tamaulipas specimens used in this study (including the type of *harrisoni*) range in wing-length from 76 to 83 mm., averaging 79.9 mm. The type of *jaliscensis* has a wing length of 84 mm. Three of my Tamaulipas specimens are so worn that their tail-length is meaningless. The range of tail-length in the eight full-tailed specimens is 77 to 87 mm. (average, 81). Nelson's tail-measurement for the type of *jaliscensis* was 89 mm. In bill-length my 11 male *harrisoni* range from 13.0 to 15.0 mm. (average, 13.8); in *jaliscensis* it is, according to its describer, 16 mm. To obtain this measurement in the type myself I had to part the feathers considerably at the base of the culmen. What one easily sees of the culmen without separating the feathers, measures 15 mm. or a little less. I know of no Jaliscan specimens of *Sittasomus griseicapillus* aside from the type.

I take pleasure in naming this new form in honor of Mr. Frank Harrison, who resides at the type locality, and who has been unfailingly kind to me and to many of my students and friends who have visited him from time to time.

Department of Zoology, University of Oklahoma, Norman, Oklahoma, May 14, 1955

GENERAL NOTES

Spring molt of the Harris Sparrow.—Accounts of the prenuptial molt of the Harris Sparrow (*Zonotrichia querula*) by Swenk and Stevens (1929. *Wilson Bull.*, 41:129–177) and Roberts (1932. "The Birds of Minnesota," 2:711) indicate that this molt is limited to the head and neck. My observations, made in Kansas in 1954, show this molt to be more extensive than described.

My problem was two-fold: (1) to ascertain the extent and sequence of the molt and (2) to correlate this molt with changes in weight of body and weight of gonads. Study material consisted of 48 freshly-collected birds and 175 study skins in the University of Kansas Museum of Natural History. The 48 birds that I collected, with assistance from William Thornberry and Norman L. Ford, were prepared as flat skins. Flat skins are especially useful for studies of molt because the papillae of new feathers are evident on the inside of the skin.

In Kansas, the prenuptial molt of the Harris Sparrow begins in the second week in March. Eight specimens taken in January (4), February (1), and early March (3) show no molt. This agrees with the information given by Swenk and Stevens (*op. cit.*: 163). In March, all specimens collected after the 12th were molting. The lateral feathers of the ventral tract, in the region of the lower breast, are the first to be replaced and molt proceeds medially as well as anteriorly and posteriorly. Replacement in the capital tract is complete but only scattered feathers of the rump and belly are molted.

The marginal and lesser coverts ordinarily are molted in spring, but replacement of greater coverts and underwing coverts at this time is incomplete. Other wing feathers appear not to be molted.

In the tail, molt in spring is consistent and is confined to the two central feathers. I found no obvious correlation between the time of molt on the tail and body. Some birds retain worn central feathers in the tail into early April, but other birds lose these feathers early in the molt.

Molt is last evident in the capital tract. The pale-edged black feathers of the crown and the brown feathers of the post-auricular spot are replaced with glossy black feathers. With the completion of the molt in late April or early May, all birds, regardless of sex or age, are in similar breeding plumage.

Total weights, along with estimates of the amount of fat, were taken from the fresh specimens. Of 38 specimens, mostly molting, collected prior to April 28, all were "moderate fat" to "fat" according to the McCabe fat scale (1943. *Auk*, 60:550–558). The weights were as follows: 19 males averaged 38.8 gm. (36.8–41.7 gm.); 19 females averaged 33.7 gm. (31.4–36.3 gm.). A female taken on May 11, in fresh nuptial plumage, was "very fat" and weighed 37.8 gm. These data seem to indicate that the Harris Sparrow does not store large amounts of fat for migratory flights until the prenuptial molt is nearly complete.

The gonads of these birds were weighed to the nearest one-tenth milligram on a torsion balance. As expected, the weight of the gonads increased as the season progressed, but the increase seemed not to be closely correlated with molt in individual birds. The average weight of the largest testis for 11 males collected between March 26 and April 16 was 3.4 mg.; two males taken on April 22 averaged 6.5 mg. Weight of the ovary increased notably in the second week in April. Ovaries of four females taken between March 28 and April 2 weighed from 7.0 to 8.0 mg. Ovaries of ten

females taken from April 8 to 23 averaged 15.1 mg. (12.0–19.0 mg.). The ovary of the female taken on May 11 weighed 35.0 mg.

In summary, spring molt of the Harris Sparrow in Kansas begins in the second week in March and is completed by late April or early May. Replacement of feathers on the head and throat is complete. At the level of the shoulders, replacement is heavy but incomplete. At the level of the rump and belly, only scattered feathers are replaced. Some wing coverts seem to be molted regularly while others are molted only sporadically. The two central tail feathers are molted consistently in spring.—GLEN E. WOOLFENDEN, *Museum of Natural History, University of Kansas, Lawrence, Kansas, January 30, 1955.*

Notes on behavior of the Wild Turkey.—The note, "Swimming by Wild Turkey poults," by Leo M. Martin and Thomas Z. Atkeson (1954. *Wilson Bull.* 66:271) brings to mind an observation of my own. On June 9, 1951, I encountered a pair of adult Turkeys (*Meleagris gallapavo*) with at least six fledglings perhaps three or four days out of the eggs. The group scattered and one of the young birds walked slowly along a large, flat dead tree extending out into a pond. Upon reaching the small outer end the bird walked off into the water without the slightest hesitation and swam leisurely some 30 yards or more to the far shore. The poult was cold and exhausted when I picked it up without difficulty a few moments later. One parent disappeared. The other remained in plain sight near at hand but showed a minimum amount of agitation. I found one cold, addled egg a few feet distant from the spot where I picked up the fledgling. A. C. Bent (1932. *U.S. Nat. Mus. Bull.* 162:339) quotes Audubon as describing young Wild Turkeys, unable to make the flight across a river, as falling in and swimming to shore. I am informed that a number of different adults, injured, have been seen swimming here.

Not mentioned by Bent is the posture in running, which is somewhat like that of the Ring-necked Pheasant (*Phasianus colchicus*). On June 4, 1949, by pure happenstance I observed an adult running almost noiselessly through the underbrush at a speed faster than that of any human. The bird carried its head and neck outstretched forwards in such a manner as to form a single plane with the back. The region in question, in the eastern United States and further north than the Potomac River, has had rigid control now for going on towards a century. Some interbreeding with domestic turkeys was permitted years ago but I am inclined to believe the dominant strain is that of the Wild Turkey, *M. g. silvestris.*—WENDELL TABER, *3 Mercer Circle, Cambridge, Massachusetts, January 27, 1955.*

Cardinal exploits Loggerhead Shrike's artificial food source.—A young Loggerhead Shrike (*Lanius ludovicianus*), barely able to fly, was brought to me on June 24, 1954. I raised this bird and freed it on September 12, 1954, in my yard, which adjoins an orchard on the outskirts of Norman, Oklahoma. With supplementary feeding, the bird established itself and has remained in this vicinity ever since. It comes once or several times a day to the electric wire just outside a kitchen window, squealing and fluttering its wings to be fed. Foodstuff, such as raw meat or cheddar cheese, tossed to the bird, usually is caught in mid-air and carried away to be eaten. The bird hangs part of its food on twigs; and I have seen meat impaled on three or four barbs of the fence.

When the shrike is hungry, a call or a rap on the windowpane will bring it up; at

other times its only response may be half-hearted begging from some distant perch. No food trays are maintained and all feedings have come from the hand, except that during six days in December, while we were away from home, the bird fed on cheese and meat placed in a fold of chickenwire fastened to the light wire beside the window.

On November 11, I noted that the shrike's leg had been broken, and for several days thereafter the bird depended largely on our feedings. However, it was not long before it again occasionally showed indifference to being fed. Once since its injury it was seen with a mouse, which it tore and ate on the ground, after futile efforts to manage it in a tree. The shrike continued to be highly intolerant of other birds, fiercely driving away Blue Jays (*Cyanocitta cristata*), Mockingbirds (*Mimus polyglottos*), Starlings (*Sturnus vulgaris*), Meadowlarks (*Sturnella* sp.) and other shrikes.

Presumably, this is a male bird. It first attempted to sing on July 9, and its song (harsh notes mingled with musical phrases of thrasher-like tones) has been noted during each month, except December. Some song periods in October and early November lasted almost 15 minutes.

Late in November a male Cardinal (*Richmondena cardinalis*) began to visit the yard. Soon I noticed that the Cardinal was following the shrike about a good deal of the time, along the back fence, where the shrike "caches" food, and from tree to tree in the orchard.

On November 25, I saw the Cardinal working with something on top of a bird-house in the fence corner, but I did not investigate. The shrike is in the habit of bringing food there to be eaten and sometimes leaving part of it. Later that day, the Cardinal came to a spot on the lawn where the shrike had fed a short time earlier and where food bits remained. I watched the Cardinal nibble at the meat three or four times before it flew.

During the next two days, the Cardinal was observed a number of times, perching along the fence about six feet from the bird-house where the shrike was busily beating meat preparatory to eating. It appeared to be watching the shrike closely. Once I saw it flying away from the nest box with a good-sized piece of cheese showing brightly in its bill, the shrike in hot pursuit. Both birds disappeared on the far side of the orchard.

On November 28, when I called the shrike to the door and fed it, the Cardinal came also. The Cardinal moved about in a nearby tree, while the shrike stood on the lawn eating ground meat. Presently the Cardinal alighted about a yard from the other bird and began to *chip* and hop about alertly, but keeping out of the shrike's reach. When the shrike flew away with part of the meat, the Cardinal at once came and took bite after bite of the remaining portion. In a few moments the shrike returned and flew at the interloper with loud *scree* scolds. The Cardinal fled and the shrike carried away the last of the food. Now the Cardinal came back and began hopping all around the area, looking for food. But when I opened the door to throw it meat, it flew off. This episode took place about 15 feet from the window where I watched.

In several instances, between December 5 and 11, when the shrike came to be fed, it was accompanied by the Cardinal. The latter hunted for and sometimes found bits of food the shrike had dropped; but I did not again see the shrike return to retrieve its food from this apparently protein-hungry fringillid.—Lovie M. Whitaker, *1204 West Brooks Street, Norman, Oklahoma, March 3, 1955.*

White-winged Crossbill eating teasel seeds.—Two White-winged Crossbills (*Loxia leucoptera*) were seen feeding on the seeds of teasel (*Dipsacus sylvestris*) growing among some young Scotch pines at Vineland Station, Ontario, on December 27, 1954. The inflorescence of this plant is an elongate head densely covered with erect, slender-tipped bracts about three-quarters of an inch long, among which the small achenes are set; it bears a rather vague resemblance to a conifer cone. As the birds perching on the heads were watched at the shortest focal limit of 8× binoculars, they quickly removed the achenes with the tips of their bills, split them with rapid movements that could not be followed, and discarded the husks.

The only other bird seen by the writer to remove the seeds from teasel heads is the American Goldfinch (*Spinus tristis*).—Wm. L. Putman, *Vineland Station, Ontario, Canada, March 7, 1955.*

Wasteful feeding by White-winged Crossbills.—On July 8, 1955, Guy Marshall reported that some birds were dropping cones from spruce trees on the campus of the University of Minnesota Forestry and Biological Station. Upon investigation, it was discovered that an adult male and three presumably immature White-winged Crossbills (*Loxia leucoptera*), were feeding on the cones of White Spruce (*Picea glauca*). The method of feeding was peculiarly wasteful in that the cones were clipped off from the cluster, held on a branch by one foot, and then a few scales were torn off and the cone was dropped. Marshall and Robinson timed the procedure for 30 minutes. Fifty-nine cones were clipped off and dropped during the half hour at a rate of 20, 20, and 19 per 10-minute period. After the birds moved on, the cones under the trees where these birds were feeding were collected and given to Hofslund for examination. A total of 619 cones weighing approximately 1230 grams was collected. Few of these had more than four or five scales torn off of them.—P. B. Hofslund, William H. Marshall, and Gerald Robinson, *University of Minnesota Biological Station, Lake Itasca, Minnesota, March 16, 1955.*

PROCEEDINGS OF THE THIRTY-SIXTH ANNUAL MEETING

BY PHILLIPS B. STREET, SECRETARY

The Thirty-sixth Annual Meeting of the Wilson Ornithological Society was held at Stillwater, Oklahoma, from Thursday, April 7, to Sunday, April 10, 1955. It was sponsored by the Oklahoma Agricultural and Mechanical College and the Oklahoma Ornithological Society.

There were four sessions devoted to papers and two business meetings. The motion picture, "Sunrise Serenade," was presented on Thursday evening, and the Executive Council met at the same time. Dr. George M. Sutton presented an illustrated talk on Friday evening, "Comments on the Distribution of Arctic Birds with Special Reference to Baffin Island Observations made during the Summer of 1953," and it was followed by a reception given by the sponsoring groups. The Annual Dinner was held in the Student Union Club on Saturday evening, President Burt L. Monroe delivering the address and the Pawnee Indian Dancers providing entertainment.

Early morning field trips were taken to Lake Carl Blackwell and to the prairie country near Pawhuska, where the Prairie Chickens performed as scheduled. The all-day Sunday field trip to the Salt Plains National Wildlife Refuge featured a buffalo barbecue luncheon.

First Business Session

President Monroe called the meeting to order at 10:00 a.m., Friday, April 8. President Oliver S. Willham, of Oklahoma A. and M. College, welcomed the Society, and President Monroe responded. The minutes of the 35th Annual Meeting were approved as published in *The Wilson Bulletin* for September, 1954.

Secretary's Report

The secretary, Phillips B. Street, summarized the principal actions taken at the previous evening's Executive Council meeting as follows:

1. Council accepted the invitation of the Buffalo Society of Natural Sciences, the Buffalo Audubon Society and the Buffalo Ornithological Society to hold the 37th Annual Meeting at Buffalo, New York, from Thursday, April 26, to Sunday, April 29, 1956.
2. Dr. Keith L. Dixon was elected editor of *The Wilson Bulletin.*

Treasurer's Report

The treasurer, Leonard C. Brecher, submitted the following report on the finances of the Society:

Report of Treasurer for 1954

General Fund

Balance as shown by last report, dated December 31, 1953		$3,120.30
Receipts		
Dues:		
Active	$3,794.00	
Sustaining	1,485.00	$5,279.00
Subscriptions to *The Wilson Bulletin*		506.25
Sale of back issues & reprints of *Bulletin*		160.55
Gifts:		
Color Plate Fund	$ 5.00	

Library Book Fund	29.75		
Miscellaneous	61.50	96.25	
Payments for Foreign Postage		6.50	
Refund from Registration Fees, Cape May Meeting		48.62	6,097.17
Total Receipts			$9,217.47

DISBURSEMENTS

The Wilson Bulletin—Printing and engraving	$3,841.96	
The Wilson Bulletin—Mailing and maintenance of mailing list	718.49	
Editor's Expense—Printing, postage, clerical aid, etc.	239.00	
Treasurer's Expense—Printing, postage, clerical aid, etc.	107.37	
Secretary's Expense—Printing, postage for Annual Meeting, etc.	139.18	
Committee and Other Officers' Expense—Printing and postage	54.18	
Purchase of Books from Book Fund for Club Library	48.50	
Purchase of Back Issues of *The Wilson Bulletin* for future sale	5.50	
Miscellaneous: State tax, Corp. Fee, box rental, etc.	10.15	
Louis Agassiz Fuertes Research Grant to William C. Dilger	100.00	
Worthless Checks charged back by bank	8.00	
Transfer of Gift to Endowment Fund	32.00	
Total Disbursements		$5,304.33
Balance on hand in Citizens Fidelity Bank & Trust Company, Louisville, Kentucky, December 31, 1954		$3,913.14

ENDOWMENT FUND

Balance in Savings Account as shown by last report, dated December 31, 1953,			$1,447.71
Receipts:			
Interest on Investments and Dividends		$ 342.95	
Transfer of Gift from General Fund		32.00	
Interest on Savings Account		20.23	
Life Membership payments		850.00	1,245.18
Total Receipts			$2,692.89
Disbursements:			
State Tax on Bank Deposits	$ 2.27		
Purchase 1 share Mass. Invest. Trust Stock	19.28		
Purchase 5 shares Mass. Invest. Trust Stock	132.00		
Purchase 30 shares Firemans Fund Ins. Stock	2,085.00		
Total Disbursements			$2,238.55
Balance in Savings Account, Citizens Fidelity Bank & Trust Company, Louisville, Kentucky, December 31, 1954			$ 454.34
*Securities owned**			
U.S. Postal Savings Coupon Bonds, dated July 1, 1935	$ 780.00		
U.S. Savings Bonds, Series "G," dated September 1, 1943 (maturity value $1,000.00)	986.00		
U.S. Savings Bonds, Series "G," dated December 20, 1944 (maturity value $1,500.00)	1,468.50		
U.S. Savings Bonds, Series "G," dated June 1, 1945 (maturity value $500.00)	488.00		
U.S. Savings Bonds, Series "G," dated July 1, 1945 (maturity value $900.00)	878.40		
U.S. Savings Bonds, Series "G," dated October 1, 1945 (maturity value $1,400.00)	1,362.20		

U.S. Savings Bonds, Series "F," dated February 1, 1947 (maturity value $2,000.00)	1,722.00	
U.S. Savings Bonds, Series "F," dated April 1, 1948 (maturity value $2,000.00)	1,670.00	
U.S. Savings Bonds, Series "F," dated October 1, 1948 (maturity value $1,450.00)	1,191.90	
U.S. Savings Bonds, Series "F," dated April 1, 1950 (maturity value $1,000.00)	786.00	
Total Value of Government Bonds	$11,333.00	
Massachusetts Investors Trust (122 shares at $27.99)	3,414.78	
Firemans Fund Insurance (30 shares at $72.00)	2,160.00	
Total Securities Owned		$16,907.78
Total in Endowment Fund,** December 31, 1954		$17,362.12

*Bonds carried at redeemable value December 31, 1954
(appreciation during the year, $218.06)
Stocks carried at closing prices December 31, 1954
(appreciation during the year, $931.50)

***In Reserve:*

Louis Agassiz Fuertes Research Fund (special gifts)	$ 425.00
S. Morris Pell Fund (special gift)	75.00

Respectfully submitted,
/s/LEONARD C. BRECHER,
Treasurer.

Membership Committee

Ralph M. Edeburn, chairman, reported that the names of 93 prospective members enrolled since the 1954 meeting were posted for the inspection of members and to be elected by vote at the final business session. On December 31, 1954, the Society had 98 life, 271 sustaining and 1249 active members, a total of 1618. Since January 1, 1955, 61 new members have been added, making a total of 1679 as of April 8, 1955. The addition of 11 new life members since January 1, 1955, is the outstanding membership achievement since the 1954 meeting. There were 154 institutional subscriptions to *The Wilson Bulletin* as of the close of 1954. The membership has been stable during the past several years.

Research Grant Committee

Kenneth C. Parkes, chairman, reported by letter that his committee, consisting of Brina Kessel, John Davis and himself, felt that the early date of the Stillwater meeting would not permit sufficient time for applications to be received and judged in view of the late publication date of the December *Bulletin* with its call for applications. Accordingly, an April 20 deadline was set. Nine applications had been received to date. (The winner subsequently selected was Robert G. Wolk, graduate student at Cornell University, who has been awarded a Louis Agassiz Fuertes Research Grant of $100 as an aid to his study, "Analysis of Reproductive Behavior in the Black Skimmer.")

Library Committee

George J. Wallace, chairman, reported that accessions to the library at Ann Arbor since last year's report totalled 1220 items, comprised of 51 books, 513 reprints, 601 magazines and 55 pamphlets. The excellent showing in reprints and magazines is largely due to an unusually large donation by Fred M. Packard. Donations were made

by 63 persons or institutions. Many persons have contributed substantially to this rapidly growing collection of library material, and some appear to have become regular contributors over the years, a habit of which the committee thoroughly approves. The remarkable growth of the library during the past six years can be visualized from the following tabulation of receipts over this period:

	1950	1951	1952	1953	1954	1955	Totals
Books	61	44	44	36	81	51	317
Reprints	1104	278	365	361	465	513	3086
Magazines	78	140	78	273	117	601	1287
Pamphlets	6	27	34	58	82	55	262
Totals	1249	489	521	728	745	1220	4952

The December, 1954, *Wilson Bulletin* carried a second supplementary book list of 49 books received since the previous listing in September, 1953. These two book lists add 92 books to those given in the complete list published in 1952.

Conservation Committee

Robert A. Pierce, chairman, reported by letter. The committee felt it important that the Society should not as an organization be diverted from its primary purpose, namely, the promotion of the study and the advance of the science of ornithology, by becoming too deeply involved in local issues better left to state and federal conservation groups, to which groups many of our members belong. Other members are engaged in professions which enable them to teach conservation or to encourage conservation in their communities. Thus, the Society is in effect a strong force for conservation through the individuals which comprise it. It was suggested that in controversial matters not purely ornithological in nature the Society might well confine itself to commendation of various organizations for conservation activities in which we, as an organization, are especially interested, and, too, that our members might well be encouraged to become active in conservation groups so that by working through these organizations we can guide their programs, as well as influence public thinking, along the lines in which we are interested.

The committee brought two matters to the attention of the Society which they felt merited thought: (1) the present program being carried out, through the Fish and Wildlife Service and various state agencies, regarding the introduction of exotic game birds, and (2) the present status of waterfowl management in the United States. As to the introduction of exotics, it was felt that the program presents certain dangers, especially with respect to the introduction of disease, of hybridization with other species already present, and of ecological maladaptation, including the crowding out of native species. With respect to waterfowl management, several changes have taken place during the last few years about which the membership should be informed, and the increase in hunters together with continued decreases in habitat may necessitate other more basic changes in the future. These are both involved issues which will be solved ultimately by the various conservation organizations concerned. It is felt, however, that the membership should be aware of the problems, the merits of existing policies and future programs, and it is planned to discuss these problems through reports in the *Bulletin*.

At the conclusion of the reading of the report, Margaret M. Nice urged those in attendance to protest the Echo Park Dam in Dinosaur National Monument, and Dr. George M. Sutton expressed similar concern over the threatened encroachment by the U.S. Army in the Wichita Mountains National Wildlife Refuge in Oklahoma.

Temporary Committees

The following temporary committees were appointed:

Auditing Committee

Harvey B. Lovell, Chairman
Mrs. Frederick W. Stamm
S. Charles Thacher

Resolutions Committee

Harvey I. Fisher, Chairman
Albert F. Ganier
Jane S. Mengel

Nominating Committee

Maurice Graham Brooks, Chairman
Aaron M. Bagg
George H. Lowery, Jr.

SECOND BUSINESS SESSION

The final business session was called to order at 10:00 a.m., Saturday, April 9.

The applicants for membership, whose names were posted, were elected to membership.

Report of the Auditing Committee

The committee's report, read by Mrs. Stamm, found the treasurer's books in order. Mr. Brecher, the retiring treasurer, was commended highly for his able and faithful performance of this exacting and time-consuming position.

Report of the Resolutions Committee

BE IT RESOLVED that the Wilson Ornithological Club express its deep appreciation to the Oklahoma Agricultural and Mechanical College and to the Oklahoma Ornithological Society for their warm hospitality and to the Local Committee on Arrangements for its effectiveness in planning this splendid meeting. It is not often that our Club is privileged to meet in such handsome quarters and in such an interesting area.

BE IT FURTHER RESOLVED that the Wilson Ornithological Club extend its sincere thanks and appreciation to our officers for their wholehearted work and enthusiasm in conducting the affairs of the Club during the past year, and especially to our retiring officers—Harrison B. Tordoff, for maintaining the high quality of *The Wilson Bulletin* during his tenure as editor; Leonard C. Brecher, treasurer, for so faithfully and successfully handling the finances of the club during the last four years; and Harold F. Mayfield, first vice-president, who is resigning because of the pressure of other ornithological duties.

BE IT FURTHER RESOLVED that the Wilson Ornithological Club express its thanks to the following retiring committee chairmen for their faithful services in the execution of those committee duties: Ralph M. Edeburn, Membership Committee; George J. Wallace, Library Committee; William H. Marshall, Conservation Committee; and to Joseph C. Howell, the retiring member of the Executive Council.

Amendment to the Constitution

The Amendment to the Constitution revising Article 1, Section 1, to read: "The organization shall be known as the Wilson Ornithological Society" was unanimously passed. The change in name becomes effective upon approval by the State of Illinois, our state of incorporation.

Election of Officers

The Nominating Committee proposed the following officers for the coming year: President, Burt L. Monroe; First Vice-President, John T. Emlen; Second Vice-President, Lawrence H. Walkinshaw; Secretary, Phillips B. Street; Treasurer, Ralph M. Edeburn; Elective members of the Executive Council, A. W. Schorger (term expires 1956), Harvey I. Fisher (term expires 1957), and Leonard C. Brecher (term expires 1958).

The report of the committee being accepted, and there being no nominations from the floor, the secretary was instructed to cast a unanimous ballot for these nominees.

PAPERS SESSIONS

Friday, April 8

H. I. Featherly, Oklahoma A. and M. College, *Natural Scenes in Oklahoma*, slides.

A. Marguerite Baumgartner, Stillwater, Oklahoma, *Nesting Birds of an Army Camp "Gone Native,"* slides.

Frederick M. Baumgartner, Oklahoma A. and M. College, *Bird Life of the Salt Plains National Wildlife Refuge.*

William R. Heard, Oklahoma A. and M. College, *Food Habits of Cave and Cliff Dwelling Owls in Northwestern Oklahoma*, slides.

Arnold J. Petersen. St. Olaf College, *Reproductive Physiology of the Female Bank Swallow*, slides.

Jere Hodshire, Wyandotte High School Science Field Club, *Evening Flights of Wintering Ducks at Wyandotte County Lake, Wyandotte County, Kansas.*

Keith L. Dixon, A. and M. College of Texas, *A Six-year Record of Plain Titmouse Territories*, slides.

Harvey I. Fisher, University of Illinois, *Landing and Take-off Forces in the Pigeon*, slides.

George J. Wallace, Michigan State College, *Problems Involved in Ornithological Textbook Writing.*

Margaret M. Nice, Chicago, Illinois, *Some Comparisons Between Development of Birds and Mammals.*

Lawrence H. Walkinshaw, Battle Creek, Michigan, and Dale A. Zimmerman, University of Michigan, *The Spread of Brewer's Blackbird in Eastern North America*, slides.

Brooke Meanley, U.S. Fish and Wildlife Service, *Blackbirds in the Arkansas Rice Fields.*

Carl D. Riggs, University of Oklahoma, *Water Birds of Lake Texoma, Texas and Oklahoma*, slides.

Saturday, April 9

John C. Johnson, Jr., University of Oklahoma, *Observation on Winter Blackbird Roosts in Central Oklahoma*, slides.

Aretas A. Saunders, Canaan, Connecticut, *A Comparison of the Songs of Three Vireos.*

Donald J. Borror and Carl R. Reese, Ohio State University, *The Accuracy of Mockingbird Imitations* (presented on tape), slides.

Frederick M. Helleiner, Acme, Alberta, *Bird Observations in the Peace River Region of Alberta, 1953-1954.*

Josselyn Van Tyne, University of Michigan, *An Expedition to Northern Baffin*, slides.

Harriet B. Woolfenden, Detroit Audubon Society, *The "How" of the Detroit Audubon's Annual Bird Survey*, slides.

John F. Wanamaker, The Principia College of Liberal Arts, *Unusual Nesting Observations of the Eastern Cardinal*, slides.

Rosalie Edge, Hawk Mountain Sanctuary Association, *Progress of Hawk Protection*, (read by title).

Lovie M. Whitaker, Norman, Oklahoma, *Some Observations on Anting.*

Robert J. Newman, Louisiana State University, *Synthetic Bird Counts—a Means of Studying Observational Variance*, slides.

Johnson A. Neff, U.S. Fish and Wildlife Service, *Albatrosses and Airplanes on Midway*, slides.

John William Hardy, University of Kansas, *Are the Thick-billed Parrot and the Maroon-fronted Parrot Really Separate Species?*

Robert W. Mitchell, Texas Technological College, *The Golden Eagle in West Texas*, motion pictures.

Attendance

Members and guests in attendance at the meeting included 169 registrants and a total probable attendance approximating 200. Twenty-three states and the Province of Alberta were represented.

From **Arkansas:** 3—*Fort Smith*, Mrs. M. J. Armstrong, Ruth Armstrong; *Stuttgart*, Brooke Meanley.

From **Colorado:** 1—*Denver*, Johnson A. Neff.

From **Connecticut:** 2—*Canaan*, Aretas A. Saunders; *West Hartford*, E. Alexander Bergstrom.

From **Illinois:** 16—*Blue Island*, Karl E. Bartel; *Chicago*, Mrs. Amy G. Baldwin, Mr. and Mrs. L. B. Nice, Millicent Stebbins; *Elsah*, Norwood Hazard, David McBane, Edwin Poole, Mac Stitt, John F. Wanamaker; *Quincy*, Mr. and Mrs. Tom Sorrill, Steven Sorrill; *Urbana*, Harvey I. Fisher, Fred Fisher, William B. Robertson.

From **Indiana:** 7—*Connersville*, Edna Banta; *Hanover*, J. Dan Webster; *Indianapolis*, Mildred F. Campbell, Mrs. S. G. Campbell; *Lafayette*, Mr. and Mrs. Albert G. Guy; *Newcastle*, Mary Rankin.

From **Kansas:** 22—*Baldwin*, Mr. and Mrs. Ivan L. Boyd; *Kansas City*, Wallace Good, Jere Hodshire and 11 members of the Wyandotte High School Science Field Club, Ben King; *Lawrence*, John William Hardy, Mr. and Mrs. Robert Mengel, Harrison B. Tordoff, S. G. Van Hoose; *Manhattan*, Mr. and Mrs. E. K. Beals.

From **Kentucky:** 7—*Anchorage*, Mr. and Mrs. Burt L. Monroe, Burt L. Monroe, Jr.; *Louisville*, Mr. and Mrs. Leonard C. Brecher, Mr. and Mrs. Frederick W. Stamm.

From **Louisiana:** 2—*Baton Rouge*, Robert J. Newman; *Shreveport*, Horace H. Jeter.

From **Maryland:** 2—*Towson*, Mr. and Mrs. Richard D. Cole.

From **Michigan:** 13—*Ann Arbor*, Mrs. R. M. Branch, Mrs. Reuben L. Kahn, Mrs. Bradley M. Patten, Josselyn Van Tyne, Mr. and Mrs. John E. Willoughby, Anne and Alden Willoughby; *Battle Creek*, Mr. and Mrs. Lawrence H. Walkinshaw; *Dearborn*, Mrs. Harriet B. Woolfenden; *East Lansing*, George J. Wallace; *Marquette*, Mrs. Mary Spear Ross.

From **Minnesota:** 4—*Minneapolis*, John G. Erickson, Scott Searles; *Northfield*, Arnold J. Petersen; *Owatonna*, Mrs. Harson A. Northrop.

From **Missouri:** 2—*Webster Groves*, Mr. and Mrs. J. M. Magner.

From **Nebraska:** 4—*North Platte*, Doris Gates, Mrs. Glen Viehmeyer; *Wisner*, Mr. and Mrs. John Lueshen.

From **New Jersey:** 1—*Tenafly*, Mrs. Betty Carnes.

From **New York:** 1—*Buffalo*, Fred T. Hall.

From **Ohio:** 7—*Cleveland*, Vera Carrothers, Adele Gaede, Mildred Stewart, Gene Wachtel, Joel Wachtel; *Utica*, Mr. and Mrs. C. R. Wagner.

From **Oklahoma:** 55—*Arcadia*, Bess Smith; *Locust Grove*, Lea Davis; *Muskogee*, Forrest Bebb, Maurice Bebb, J. L. Norman, Mr. and Mrs. Vaud A. Travis; *Norman*,

Charles C. Carpenter, John C. Johnson, Jr., Carl D. Riggs, George M. Sutton, Mrs. Lovie M. Whitaker, Johnny Wiens, Ruth Updegraff; *Oklahoma City*, John Baxter, A. E. Borell, Gladys L. Burnham, Wallace Hughes, Mr. and Mrs. J. E. Martin, Sam Moore, Allan J. Stanley, Eliot J. Stanley; *Ponca City*, Helen Bangs, Mrs. Delia Castor, Mr. and Mrs. Joe C. Creager, C. F. Franklin, William O. Ney, Jr., Mr. and Mrs. J. Frank Pieratt; *Skiatook*, Helen Rogers; *Stillwater*, Mrs. James H. Arrington, Mr. and Mrs. Frederick M. Baumgartner, Milton D. Baumgartner, Mrs. William C. Fawcett, Mr. and Mrs. Colly Hitt, Mr. and Mrs. H. S. Mendenhall, Mr. and Mrs. Ford Mercer, Mr. and Mrs. O. M. Smith, Mrs. Grady Thompson; *Tahlequah*, A. F. Bennett; *Tulsa*, Mrs. Roy L. Ginter, Mable L. Hagan, Mr. and Mrs. Orrin W. Letson, Mr. and Mrs. Bruce Reynolds, John Tomer; *Wakita*, Mrs. Glen Stuart.

From **Pennsylvania:** 2—*Chester Springs*, Phillips B. Street; *Narberth*, Philip A. Livingston.

From **South Dakota:** 5—*Sioux Falls*, Mr. and Mrs. H. F. Chapman; Mr. and Mrs. J. S. Findley, Herbert Krause.

From **Tennessee:** 3—*Nashville*, Albert F. Ganier; *Knoxville*, Mr. and Mrs. Joseph C. Howell.

From **Texas:** 8—*College Station*, Mr. and Mrs. Keith L. Dixon, Terrell Hamilton; *Commerce*, Mrs. Mike O'Neil; *Edinburgh*, Pauline James; *Lubbock*, Mr. and Mrs. Robert W. Mitchell; *Midland*, Nance G. Creager.

From **West Virginia:** 3—*Huntington*, Ralph M. Edeburn; *Morgantown*, George A. Hall, Earl N. McCue.

From **Wisconsin:** 1—*West Bend*, Marvin E. Vore.

From **Alberta, Canada:** 1—*Acme*, Frederick M. Helleiner.

THE WILSON ORNITHOLOGICAL SOCIETY LIBRARY

The following gifts have been recently received. From:

William H. Burt—5 reprints
Donald E. Burton—1 magazine
G. Reeves Butchart—1 book
H. F. Chapman—19 magazines
Sigfrid Durango—1 book
W. W. H. Gunn—1 phonograph record
Karl W. Haller—4 bulletins, 13 books, 2 reprints
F. Haverschmidt—2 reprints
Philip S. Humphrey—1 magazine
Leon Kelso—1 pamphlet
R. Lehrman—9 magazines
Purdue University Forestry Department—1 book, 4 pamphlets
Alexander F. Skutch—1 reprint
Sociedad de Ciencias Naturales La Salle—4 bulletins
Robert W. Storer—10 reprints
Josselyn Van Tyne—10 reprints
Olive P. Wetherbee—2 reprints
Nixon Wilson—2 bulletins
Henry L. Yeagley—2 reprints
Dale A. Zimmerman—1 reprint

CONSTITUTION AND BYLAWS OF THE WILSON ORNITHOLOGICAL SOCIETY*

As adopted December 29, 1930, and amended by the Executive Council on August 11, 1944, and October 13, 1945; the revised Constitution and Bylaws were approved by the membership on November 29, 1946, and amended September, 1951 (mail ballot), and April 9, 1955.

CONSTITUTION

Article I

Name and Object

Section 1. The organization shall be known as the "Wilson Ornithological Society."

Section 2. The object of the Wilson Ornithological Society shall be to advance the science of ornithology, particularly field ornithology as related to the birds of North America, and to secure cooperation in measures tending to this end by uniting in a group such persons as are interested therein, facilitating personal intercourse among them, and providing for the publication of the information that they secure.

Article II

Membership

Section 1. The membership of this society shall consist of five classes: Active Members, Sustaining Members, Life Members, Patrons, and Honorary Members.

Section 2. Any person who is of good moral character and in sympathy with the object of this society may be nominated for membership. Nominations and applications for membership shall be made through the Secretary. Applications for membership shall be endorsed by at least one member. Members shall be elected at the annual meeting by a majority of the members present. Nominations presented in the interim between annual meetings shall be received and confirmed by the Secretary, subject to ratification at the next annual meeting.

Section 3. The annual dues of Active Members shall be three dollars ($3.00); and of Sustaining Members, five dollars ($5.00). Any member may become a Life Member, exempt from further dues, by making a payment into the endowment fund of the Society of one hundred dollars ($100.00). Any member may become a Patron, exempt from further dues, by making a payment into the endowment fund of the Society of five hundred dollars ($500.00) or more. Upon the unanimous recommendation of the Executive Council, honorary membership may be conferred by the Society by a three-fourths vote at any annual meeting.

Section 4. All members shall be entitled to vote and to hold office.

Section 5. All annual dues for the ensuing year shall be due on January 1. Any member in arrears for dues for one year shall be dropped from the roll of members, provided that two notices of delinquency, with an interval of two months between them, shall have been sent to such member.

Article III

Officers

Section 1. The officers of this society shall be a President, two Vice-Presidents, a Secretary, a Treasurer, and an Editor. The duties of these officers shall be those usually pertaining to their respective offices.

Section 2. All officers except the Editor shall be elected at the annual meeting by ballot of the members. The Editor shall be elected annually by the Executive Council.

* Incorporated under the laws of the State of Illinois on October 16, 1944.

Section 3. Officers shall hold office for one year, or until their successors are elected, and shall be eligible for re-election. Their term of office shall begin at the close of the meeting at which they are elected.

Section 4. The officers of the Society, all past Presidents of the Society, and three additional members who shall be elected by ballot of the Society, shall constitute an Executive Council. The Executive Council shall also constitute the Board of Directors of the Corporation. The business of the Society not otherwise provided for shall be in the hands of the Executive Council, which shall pass upon any urgent matters that cannot be deferred until the next annual meeting. Five members of the Council shall constitute a quorum.

Section 5. Vacancies in the staff of officers, occurring by death, resignation, or otherwise shall be filled by appointment of the Executive Council, but the person so appointed shall hold office only until the close of the next annual meeting of the Society, except in the event of his election to that office by the members of the Society.

Article IV

Meetings

Section 1. The Executive Council shall determine the time and place of meetings of the Society.

Section 2. Twenty-five (25) members shall constitute a quorum for the transaction of business.

Article V

Accounts

Section 1. A committee of two shall be appointed annually by the President to audit the accounts of the Treasurer.

Section 2. The proper care of an Endowment Fund shall be provided for by a Board of Trustees. This Board shall consist of three members appointed by the President, one member for one year, one for two years, and one for three years. At the expiration of each respective term, a member shall be appointed for three years. Any vacancy on the Board, occurring by death, resignation, or otherwise, shall be filled for the unexpired term.

Article VI

Amendments

Section 1. This constitution may be amended at any annual meeting by a two-thirds vote of the members present, provided that the amendment has been proposed at the preceding annual meeting or has been recommended by a two-thirds vote of the Executive Council, and a copy has been sent to every voting member of the Society at least one month prior to the date of action.

Article VII

Bylaws

Section 1. Bylaws may be adopted or repealed at any annual meeting by a majority vote of the members present.

BYLAWS

1. Notice of all meetings of the Society shall be sent to all members at least one month in advance of the date of the meeting.
2. The time and place of the business session shall be published prior to the opening session of the annual meeting.
3. A program committee, of which the Secretary shall be chairman, and a local committee on arrangements for the annual meeting shall be appointed by the President at least ninety days in advance of the meeting.

4. Election of officers, except the Editor, shall be by ballot, but by the unanimous consent of the members, the Secretary may cast one ballot, representing the unanimous vote of the members present. A nominating committee shall be appointed by the President at the beginning or in advance of the annual meeting, which shall offer nominations of officers to serve the Society during the ensuing year. Nominations may also be made by any member in good standing from the floor.
5. A committee on resolutions, consisting of three members, shall be appointed by the President at the beginning or in advance of the annual meeting.
6. The accumulation and care of one or more Wilson Ornithological Society Libraries shall be provided for. A library committee of three or more members shall be appointed annually by the President.
7. The Executive Council shall have power to expel any person found unworthy of membership in the Society.
8. The official organ of the Society shall be *The Wilson Bulletin*. It shall be sent to all members not in arrears for dues.
9. Any member three months in arrears for dues shall be ineligible to vote or to hold elective office in the Society.
10. The fiscal year of this Society shall be the calendar year.
11. The order of business at regular annual meetings shall be as follows:
    1. Calling of meeting to order by the President.
    2. Reading and approval of minutes of the previous meeting.
    3. Reports of officers.
    4. Appointment of temporary committees.
    5. Election of members.
    6. Business.
    7. Reports of committees.
    8. Election of officers.
    9. Adjournment.

    The program may be interpolated in the order of business according to convenience.
12. The rules contained in Roberts' Rules of Order shall govern the Society in all cases to which they are applicable and in which they are consistent with Constitution and Bylaws of the Society.
13. If no annual meeting can be held, election of officers may be conducted by a mail ballot.
14. This constitution may be amended by mail ballot provided that the amendment has been recommended by a two-thirds vote of the Executive Council, and a copy has been sent to every voting member of the Society at least two months prior to the date of action.

ORNITHOLOGICAL LITERATURE

BIRDS OF THE WORLD: THEIR LIFE AND HABITS. By Paul Barruel. Oxford University Press, 1955:8¾ × 11 in., 204 pp., 16 col. pls. [included in pagination], and many photographs and drawings. $12.50.

This splendidly illustrated volume has been translated from the French edition by the well-known English ornithologist, Phyllis Barclay-Smith. In spite of its title, the book is by no means a "Birds of the World" in the sense of Knowlton or Makatsch, for example. Indeed the prospective reader would have been more correctly informed if the publishers had retained the title of the French edition, "The Life and Habits of Birds."

The text is interestingly written and amazingly accurate, considering its world-wide scope; one regrets that there are only about 75 pages of it. Doubtless the several small misprints will be eliminated from the next edition.

Four of the sixteen color plates are from photographs; the rest are from paintings by the talented author of the book. While bold and almost diagrammatic in treatment, the paintings are very effective and add much to the book's attractiveness; three that appeared in the French edition have been replaced by others which, if rather less artistic, do certainly convey much more ornithological information. Unfortunately the publishers have grouped all of the legends for the color plates in the back of the book, where only the more persistent and industrious reader will find them.

The photographic illustrations, contributed by some of the most distinguished photographers of England, the Continent, and America, are not only superb photographs and well reproduced but each illustrates a point the author has made in his account of the biology of birds. The value of the photographs would be increased if they were accompanied by data and if they were listed for easier reference.

Only about half of the species mentioned in the color-plate legends are identified by scientific name. Even the index contains no scientific equivalents, though such vernacular names as "Gray Jumper" and "Desert Trumpeter Bullfinch" will overtax the resources of most readers.

This very interesting and attractive volume can be recommended wholeheartedly to layman and ornithologist alike.—JOSSELYN VAN TYNE.

FINDING BIRDS IN MEXICO. By Ernest Preston Edwards. Amherst Publishing Co., Amherst, Va., 1955: 6 × 8¾ in., xix + 101 pp., 7 sketch-maps and 7 black-and-white plates (2 by Frederick K. Hilton, 5 by the author). Obtainable from E. P. Edwards and Co., Box 611, Amherst, Va. $1.90.

No bird student contemplating a trip to México should be without this practical, paper-bound guide, which affords both the novice and the initiated a goodly amount of useful information.

The introduction contains numerous suggestions of a general character, notes on climate, vegetation and topography, and a sketch-map showing México divided into six rather distinct regions: highlands, Atlantic lowlands, Pacific lowlands, Chiapas, Yucatán peninsula, and Baja California.

Each region has been given its own chapter which uniformly includes the following: 1.) a map showing the extent of paved highways and the location of selected bird-finding localities along them; 2.) a general definition of the region with a brief indication

of its vegetational and topographical characteristics; 3.) the names of from 30 to 72 of the region's most common birds, arranged according to their preferred habitats; 4.) a list of bird-finding localities.

There are 56 of the last-named, and, though well distributed throughout the Republic, they have evidently been chosen primarily for accessibility and for having satisfactory accommodations, many of which are specified. Dr. Edwards has visited all but one of the 56 localities he discusses, and for most of them he lists at least a few species actually encountered. In many cases he provides adequate directions for finding these birds. It may be disappointing to the reader, however, that certain common North American birds are mentioned so frequently, while some of the more sought-after exotic specialties are not included. For example, a somewhat hasty count shows the widespread Boat-tailed Grackle and Black Vulture cited 26 and 19 times, respectively. By contrast, not a single locality is given for any member of the following notable families: Boat-billed Herons (Cochlearidae), Sun-grebes (Heliornithidae), Thick-knees (Burhinidae), Potoos (Nyctibiidae), Jacamars (Galbulidae), Puffbirds (Bucconidae), Antbirds (Formicariidae), and Manakins (Pipridae). Obviously, when dealing with an avifauna as large and imperfectly known as México's, a book of this type cannot be expected to be complete. It is to be hoped, however, that a later edition will fill in some of the more important omissions.

Following the six regional chapters the author presents outlines of eight "sample bird-finding tours" set up for from two to 25 days, next a list of about 20 possible camp sites, and then a brief habitat directory.

Of considerable value is an apparently complete list of up-to-date scientific and common names of all bird species known from México (except extinct species and accidentals not recorded from that country during the last 30 years). Here, as elsewhere throughout the book, common names are printed in lower case letters for birds shared by México and the United States, while capital letters set off species not found north of México. In addition, symbols have been employed roughly indicating in what part(s) of México each species breeds; the absence of symbols indicates transient status. Naturally in a compilation of this kind there are a number of minor inaccuracies. For example, since the hummingbirds *Campylopterus hemileucurus* and *Amazilia beryllina* both breed regularly in the Atlantic lowlands, as defined by Edwards, they should be accorded symbol A (page 79). Many of the letters in the scientific names in this chapter are slightly out of line, but otherwise the printing is satisfactory.

Seven adequate plates depicting about 80 species should prove of real help in the field identification of such difficult groups as the Mexican trogons, swifts, motmots, woodpeckers, woodcreepers (Dendrocolaptidae), and certain hawks.

A directory of paved portions of national highways, a glossary of the native names of about 50 Mexican birds, and an index to localities (unfortunately not to birds also) complete this commendable little book.—Frederick W. Loetscher, Jr.

The Passenger Pigeon: Its Natural History and Extinction. By A. W. Schorger. University of Wisconsin Press, Madison. 6×9¼ in., xiii+424 pages; 5 tables; 22 figures. 1955. $7.50.

Every worthy subject eventually find biographers. In the fullness of time someone, with wider perspective and more exacting scholarship, writes the "Definitive" history, so recognized by contemporaries and later generations. It seems safe to predict that Dr. Schorger has performed this service for the Passenger Pigeon (*Ectopistes migratorius*).

Because forty years have passed since the last known Passenger Pigeon died, the raw data on which the historian must depend are at hand. Unless isotope chemistry or some other scientific magic unlocks wholly unsuspected doors, the lines of inquiry have been explored, and the returns are in. Those who have even seen a live wild pigeon must call on sixty-year memories. The Passenger Pigeon was, and was not, for God, with a mighty assist from humankind, took it.

No one who reads Dr. Schorger's book will long fail to realize that he is entering an ornithological world which, by any of this generation's standards, is fantastic. In numbers, in food consumed, in power of flight, in habits and extent of nesting, even in the species' biological wastefulness, here is a unique creature with which we can find nothing to compare. In most past human experiences we can trace at least a thread into the present; with the death of the wild pigeon the thread was broken.

Take, for example, the matter of numbers. Alexander Wilson estimated a flock that he saw at 2,230,272,000 pigeons. Audubon cut this number in half as his estimate of a flock which he experienced. Presumably, these were as well-trained observers as we had early in the Nineteenth Century. Discount the figures by any percentage you please, it's still a lot of birds. Or put it another way. Roger Tory Peterson, in one of his books, estimates the breeding bird population of the United States at around six billion individuals. Schorger offers the guess that Passenger Pigeons numbered three billion, and may have reached five billion. He concludes, "It is possible that at one time this pigeon formed 25 to 40 per cent of the total bird population of the United States."

Consider the amounts of food consumed. Audubon's 50 per cent reduction of Wilson's figures still allowed him to conclude that his flock would require 8,712,000 bushels of mast, mostly acorns and beechnuts, per day. Since wild pigeons ate a wide variety of foods, and since domestic grain and garden crops were favorite items, it is no wonder that on more than one occasion the Jesuit fathers in Canada pronounced solemn excommunication upon pigeon-kind.

A business grew up in the extraction of fat from squabs. Barrels of this oil were shipped down the Susquehanna River, to be used for cooking or soap-stock. So cheap and abundant were carcasses of squabs and adult pigeons around the nesting grounds that shippers could take 60 per cent losses and still have a profitable business. Thousands of live pigeons were used as targets in the rapidly-developing pastime of trap-shooting. Ornithologists today will smile wryly when they read that in 1872 Ruthven Deane was one of two persons who purchased 200 birds for a shoot, and that one of the contestants was William Brewster.

This volume contains much information which is not, I believe, known to most bird students. Let me cite an example. When I was a small boy I remember my father's receiving a letter from a mountain hunter in which the writer was positive that he had seen a flock of about twenty "wild pigeons" (this would have been around 1909). The "cracker" or punch-line was properly reserved for the last: he concluded that one reason he thought they might not be wild pigeons was that they all flew down and alighted on Elk River. I have told this story many times, and no hearer has told me that the writer was within the bounds of possibility. On page 24 of Dr. Schorger's book I learn that Passenger Pigeons regularly alighted on bodies of water.

For the data which he presents, Schorger consulted something like 10,000 published titles. This sort of bibliography must place the Passenger Pigeon on a numerical footing with George Washington, Benjamin Franklin, or Theodore Roosevelt — almost in the class of Lincoln, Napoleon Bonaparte, and Hamlet.

After a consideration of all the fanciful explanations advanced to account for the disappearance of the Passenger Pigeon, Dr. Schorger dismisses each one until there remains this simple, stark conclusion. Sometime during the late years of the past century, human beings began killing the birds at such a rate as to make annual losses exceed annual replacements. From that moment the species was doomed. There were, of course, losses from other causes. The biologic "rigidity" of the species, its inability to adapt itself to new situations and surroundings, contributed to the final disaster. But the first cause of this loss was human greed.

Perhaps the long view of history will one day see the death of the Passenger Pigeon as a turning point — a hinge on which swung the conservation of our renewable resources. The disappearance of wild pigeon flocks and buffalo herds in one generation proved that no such things as "inexhaustible" resources exist. There can be little doubt that some species are living today because the pigeons died.

This tale of the wild pigeons is a part of the American epic. Dr. Schorger has gathered and preserved for us a portion of our heritage. As we, in wonder, read his pages, we may perhaps hear again "the rustle of their wings."—Maurice Brooks.

Birds of Washington State. By Stanley G. Jewett, Walter P. Taylor, William T. Shaw, and John W. Aldrich. University of Washington Press, published in cooperation with the U.S. Department of the Interior, Fish and Wildlife Service, 1953: 9½ × 7 in., i-xxxii+1-767 pp., 12 color plates, 99 photographs, 51 maps in text, 1 pocket map, cloth cover. $8.00.

Ornithologists of all levels of attainment will welcome the appearance of this treatise on the birds of one of the more fascinating and varied parts of the west. Forty-four years have elapsed since the publication of "Birds of Washington" by Dawson and Bowles. In this interval far-reaching changes have taken place in the state of Washington and in our knowledge of the birds of the Pacific northwest.

It would be difficult to find men better acquainted with the fauna of the northwest than Stanley Jewett, Walter Taylor, and William Shaw. The manuscript in its original form was written by Taylor; much was contributed to this version by William Shaw. Jewett has revised the text and added recent records, while Aldrich is responsible for the nomenclature, the checking of distributional records, and bibliography.

The first section of the book is a systematic classification of the birds of Washington, a listing of the species and subspecies under orders and families. The introduction includes well-illustrated sections on topography of the state and life-zones. The discussions of life-zones include lists of characteristic plants, birds and mammals. A history of ornithology in the state begins with Lewis and Clark and mentions many contemporary workers. Shorter sections deal with birds and reclamation, conservation of birds, national wildlife refuges in Washington, and introduced exotic birds. The species accounts take up the greater part of the book, and are followed by a hypothetical list, a gazetteer, and a bibliography.

The accounts of species are headed by common and scientific names together with a list of "other names" which mentions common names in local use. In small type are sections on status in Washington, description of male, female, young, and downy young (where applicable), nest and eggs, and a summary of the distribution of the species in the state. Following this is an extensive section on natural history. These are on the whole informative and well written and contain comments on nesting, migration, feeding, abundance, and range changes. Much of this material is seemingly based

upon the observations of Taylor and Shaw made in the first quarter of the present century. References to observations made by "our party" and "we" presumably are to be attributed to these workers. In other cases statements are backed by literature citations, by reference to individuals who have contributed to the work, or are undocumented.

The reviewer objects to the use of subspecific common names. This practice has been followed throughout the book. The bibliography contains one entry as late as 1952; the great majority are from the 1920's or earlier. The fact that few of the non-taxonomic citations in the text date from later than the 1920's leads one to wonder if the more recent literature were examined as closely as it might have been. The illustrative material is, on the whole, excellent, but the cover jacket drawings are poor and add little to the attractiveness of the book.

Washington is a critical area for the study of the relationships of closely-related Rocky Mountain and coastal species. Knowledge of these relationships is essential to the solution of many problems of Pleistocene range changes and speciation. It is therefore somewhat disappointing to find that more detailed systematic comments on such species as the Blue Grouse (*Dendragapus obscurus*) and the Canada Jay (*Perisoreus canadensis*) were not included.

The above criticisms are of a minor nature. "Birds of Washington State" contains a vast amount of information well organized and presented. It represents a firm groundwork upon which northwestern naturalists may build. The authors are to be commended for producing this major contribution to western ornithological literature.—JAMES S. FINDLEY.

This issue of *The Wilson Bulletin* was published on November 9, 1955.

EDITOR OF THE WILSON BULLETIN

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WILLIAM A. LUNK

SUGGESTIONS TO AUTHORS

Manuscripts intended for publication in *The Wilson Bulletin* should be neatly typewritten, double-spaced, and on one side only of good quality white paper. Tables should be typed on separate sheets. Before preparing these, carefully consider whether the material is best presented in tabular form. Where the value of quantitative data can be enhanced by use of appropriate statistical methods, these should be used. Follow the A. O. U. Check-List (fourth edition) and supplements thereto insofar as scientific names of United States and Canadian birds are concerned unless a satisfactory explanation is offered for doing otherwise. Use species names (binomials) unless specimens have actually been handled and subspecifically identified. Summaries of major papers should be brief but quotable. Where fewer than five papers are cited, the citations may be included in the text. All citations in "General Notes" should be included in the text. Follow carefully the style used in this issue in listing the literature cited. Photographs for illustrations should be sharp, have good contrast, and be on glossy paper. Submit prints unmounted and attach to each a brief but adequate legend. Do not write heavily on the backs of photographs. Diagrams and line drawings should be in black ink and their lettering large enough to permit reduction. The Illustrations Committee will prepare drawings, following authors' directions, at a charge of $1 an hour, the money to go into the color-plate fund. Authors are requested to return proof promptly. Extensive alterations in copy after the type has been set must be charged to the author.

A WORD TO MEMBERS

The Wilson Bulletin is not as large as we want it to be. It will become larger as funds for publication increase. The Society loses money, and the size of the *Bulletin* is cut down accordingly, each time a member fails to pay dues and is put on the 'suspended list.' Postage is used in notifying the publisher of this suspension. More postage is used in notifying the member and urging him to pay his dues. When he does finally pay he must be reinstated on the mailing list and there is a publisher's charge for this service. The *Bulletin* will become larger if members will make a point of paying their dues promptly

NOTICE OF CHANGE OF ADDRESS

If your address changes, notify the Society immediately. Send your complete new address to the Treasurer, Ralph M. Edeburn, Dept. of Zoology, Marshall College, Huntington 1, West Virginia. He in turn will notify the publisher and editor.